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CONTENTS.

TRANSACTIONS OF THE SOCIETY.

	PAGE
I.—PRESIDENTIAL ADDRESS : RESOLUTION AND VISIBILITY IN MEDICAL MICROSCOPY. By J. E. BARNARD, F.R.S. ..	1
II.—FURTHER OBSERVATIONS ON PULMONARY ASBESTOSIS, WITH SPECIAL REFERENCE TO ASBESTOS DUST AND THE CURIOUS BODIES FOUND IN THE LUNGS. By W. E. COOKE, M.D., F.R.C.P., F.R.M.S., and C. F. HILL, M.Inst.M.M., A.Inst.P., F.R.M.S.	15
III.—CELL NOMENCLATURE. By J. BRONTË GATENBY, B.A., D.Phil., D.Sc., F.R.M.S.	20
IV.—THE PROJECTOGRAPH. AN OPTICAL INSTRUMENT FOR THE PROJECTION OF IMAGES OF MICROSCOPICAL OBJECTS. By T. E. WALLIS, B.Sc., F.I.C., Reader in Pharmacognosy, University of London ; Lecturer to the Pharmaceutical Society of Great Britain	30
V.—A MICROSCOPE LAMP. By F. WELCH, F.R.M.S.	34
VI.—SOME NEW FORAMINIFERA FROM THE SOUTH ATLANTIC.—III. By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.	38
VII.—THE FORAMINIFERA OF THE PLYMOUTH DISTRICT.—I. By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.	46
VIII.—THE FORAMINIFERA OF THE PLYMOUTH DISTRICT.—II. By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.	161

IX.—NOTES ON THE PREPARATION BY CHEATLE'S METHOD OF THIN MICROSCOPE SECTIONS OF WHOLE ORGANS EMBEDDED IN PARAFFIN. By T. D. HAMILTON	200
X.—ON THE ORIGIN OF YOLK IN THE EGG OF <i>Ostrea cucullata</i> . By HARDIT SINGH RAI, M.Sc., Royal Institute of Science, Bombay	210
XI.—AN EMBEDDING APPARATUS FOR RESEARCH WORKERS. By A. CRAIG-BENNETT, Department of Zoology, Edinburgh ..	218
XII.—A SIMPLE METHOD FOR ESTIMATING "OSMIC ACID," WITH SOME APPLICATIONS TO CYTOLOGICAL TECHNIQUE. By RICHARD PALMER, B.Sc., Dept. of Zoology, University College, London	221
XIII.—EARLY ACHROMATIC MICROSCOPES BY JAMES SMITH. By REGINALD S. CLAY and THOMAS H. COURT	297
XIV.—FROZEN SECTION TECHNIQUE. By E. G. MILLER, F.R.M.S. (From the Laboratory of the Imperial Cancer Research Fund, London)	302
XV.—THE MEASUREMENT OF SPHERICAL ABERRATION IN HIGH NUMERICAL APERTURE OBJECTIVES BY INTERFEROMETRY. By J. SMILES, F.R.M.S.	307
XVI.—METALLOGRAPHY AT LOW TEMPERATURES. By WALTER ROSENHAIN, D.Sc., F.R.S., and A. J. MURPHY, M.Sc., National Physical Laboratory	316
XVII.—ILLUMINATION OF METALLURGICAL SPECIMENS. By CONRAD BECK, C.B.E., F.R.M.S.	319
XVIII.—PHENOMENA OF HETEROTYPIC DIVISION IN THE POLLEN MOTHER-CELLS OF A TETRAPLOID FORM OF <i>Rumex scutatus</i> var. <i>typicus</i> . By M. A. FIKRY, Ph.D.	387
XIX.—THE OTOLITHS OF SMALL EELS FROM THE RHINE. By A. GANDOLFI HORNYOLD, D.Sc., F.R.M.S.	420
XX.—HYRAX, A NEW MOUNTING MEDIUM FOR DIATOMS. By G. DALLAS HANNA. (California Academy of Sciences, San Francisco, California)	424

	PAGE
XXI.—MICROSCOPICAL STUDIES IN PERNICIOUS ANÆMIA.—I. By	
W. E. COOKE, M.D., F.R.C.P.E., D.P.H., and C. F. HILL,	
M.Inst.M.M., A.Inst.P., F.R.M.S.	427

A SUMMARY OF CURRENT RESEARCHES RELATING TO
 ZOOLOGY, BOTANY AND MICROSCOPY,
 NOTICES OF NEW BOOKS,
 AND THE
 PROCEEDINGS OF THE SOCIETY.

JOURNAL
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MARCH, 1930.

TRANSACTIONS OF THE SOCIETY.

PRESIDENTIAL ADDRESS :

I.—RESOLUTION AND VISIBILITY IN MEDICAL MICROSCOPY.

By J. E. BARNARD, F.R.S.

(Delivered March 19, 1930.)

FOUR PLATES AND THREE TEXT-FIGURES.

AN independent observer, intent on estimating the relative value of various branches of science, might not, at the present time, be inclined to assign to microscopy a high place. It might even be suggested that microscopy is not a branch of science at all ; it now only deals with the use of a particular instrument in any scientific work to which it may be applied. There is, I think, little doubt that a microscope is becoming a laboratory tool rather than a highly specialised scientific instrument, much as some few workers may regret the change. It is a change that may have an effect on the work and interests of this Society, founded as it was by those who regarded no effort too great and no time spent too long if a result could be obtained which they sought, and which did appear to them to be even a slight advance on anything previously achieved. If I may express my own purely personal opinion, I am often in doubt as to the position to-day—whether, in fact, the branch of science in which we are interested is advancing along the path that is open to it. It is common knowledge that present-day advances are almost entirely due to more exact methods, to the consideration of quantities that but a few years ago were regarded as negligible. And yet

at no time in its history, if we are to judge by what is to be seen around us, was less trouble taken to get the very utmost out of a microscope, and this at a time when the problems awaiting solution were never so difficult. Let me stress the point that I am not referring to workers in any particular branch, but to the general average. It may be that the microscope now has much wider application, particularly in industry, but I am doubtful whether this is the real explanation of its apparent decline. If I may take bacteriology as an example—some may say it is not an example, but an exception—then there is little doubt that the direction in which research is proceeding is away from microscopic methods altogether. For diagnostic purposes, no doubt, as much work as ever is done with the microscope, but much of this is in connection with diseases that are due to known micro-organisms. It is significant that the Medical Research Council is publishing one of the most comprehensive works on bacteriology that has ever been produced—at least, in our language—and that it is almost devoid of illustrations. In a notice, in a well-known medical journal, of one volume—there are, I believe, to be nine volumes to complete the work—the following is the concluding sentence: “There are no illustrations, which some may regret, while others may rejoice that bacteriology has passed away from its morphological leading-strings.” And yet, much as I regret a tendency that does seem to me to be in evidence just now, I am no pessimist, because I feel sure that sooner or later there will be a change of fashion that will bring the microscope into its own again. Such a change might take place at any moment, should a fundamental discovery be made by its aid that was generally accepted. For instance, could what is known as the filtrable virus problem be placed on a sound basis by direct observation, either photographic or visual, then I am quite sure a complete change of attitude would result. Assuming that a virus is a living organism, differing mainly, though it can hardly be entirely, from any other small organisms but in size, then it is evident that a comparable increase in optical efficiency of the microscope would render a solution possible. I say possible rather than probable, as there are always other factors that intervene in biological work, and at present these are the real obstacles to more definite progress.

If we choose to take a very broad view of the outlook in the determination of the nature of very small structures, it would be difficult to imagine a more promising outlook. Already the term “X-ray optics” is becoming general, and the results obtained in the determination of crystal structure is an object-lesson that we may be unwise to disregard. In principle the observation of a small object by means of the microscope is similar to X-ray analysis—both are limited by the wave-length employed. In the microscope we must have visibility as well as resolution; the latter only attains its full value when visibility is at its maximum. To see an atom a magnification of the order of one hundred million diameters would be needed, using a radiation of appropriate wave-length as an illuminant; but it is difficult to imagine a body, if it is in order to refer to an atom in these

terms, of such a size having sufficient visibility in any ordinary microscopic sense. It is therefore permissible to regard the limits of microscopic observation as being comparable to the limitations and the possibilities of X-ray analysis. In the latter case the wave-length is several thousand times smaller than visual light used in a microscope, and X-rays can be used which are of short wave-length compared to the size of a molecule. Whether atoms or molecules are being dealt with, it is a group effect that is obtained. It needs instruments of high accuracy for the practical side of the work, and mathematical knowledge to interpret the results. Such advances in the use of invisible radiations might at first glance discourage those who are still struggling to improve microscopical methods, even by the use of ultra-violet light. There is, however, no reason whatever to relax effort in this direction. The problems are there for any possible advance, but the main point to bear in mind is that results will only be obtained by more exact technique, better appliances, both optical and mechanical, and increased skill on the part of the worker. This Society has had a noteworthy discussion, during the past year, on the theory of microscopic vision, and considerable interest has again been aroused in a subject that has had much space devoted to it in our Journal during the last forty years. I do not intend to make any attempt to appraise the value of the discussion; it has apparently added some new knowledge to a debatable subject, without arriving at a final decision or completely removing all need for further consideration. It did, however, differ from some occasions that I can remember: the Chairman had no need to close the meeting because remarks were becoming too personal, nor did he have occasion to remind the participants that "the hour was now 10.30." A well-known Fellow of our Society did, however, suggest to me that the two opposing schools of thought—those who would still regard microscopic images as comparable, whether they were illuminated by plain parallel beams or convergent cones, solid or hollow—are coming much closer together. If this is so, it is a step forward, and will be of assistance to the practical microscopist who is struggling to get the last bit out of his apparatus. I am, in this address, making no attempt to pursue the subject of resolution from a theoretical aspect, but it did seem to be worth while to bring to your notice some few practical examples that are within my own experience. I should like to remind you, however, that on the theoretical side there is no need to search for information outside our own Journal. The papers by the first Lord Rayleigh are in themselves so comprehensive, so concise, and understandable that there is little need to go beyond them to appreciate the principles determining the limits of visibility and of resolution.

The association of visibility with resolution is a very close one; it is, in fact, impossible to obtain the utmost benefit of high-aperture objectives unless the object is one that gives perfect contrast and is mounted suitably. There are so few biological papers in which the possibility and limitation of the microscope are recognised that it is a pleasure to draw attention to one published in the Proceedings of the Royal Society, series B, vol. 105, on

"The Morphology and Cytology of *Bacterium malvacearum*," by R. H. Stoughton, B.Sc. Mr. Stoughton says that this organism has hitherto been described as possessing no internal structure, and as multiplying solely by transverse fission. He describes a technique for staining the organism without previous drying or fixing, with the result that structure is demonstrated which is suggestive of nuclear division. The paper is fully illustrated, and is of more than usual interest. The point to which I would draw attention is the difficulty Mr. Stoughton has in obtaining the full resolving power of his optical system. His stained granules inside the cell are, in any case, at the limit of resolution, in some cases beyond it, as the images in his illustrations demonstrate. These stained granules are not immersed in a medium of the same refractive index as the immersion oil used with the objective; they do not, in fact, conform to the conditions of homogeneous immersion or of a homogeneous optical system. They are in a protoplasmic substance differing little from water in refractive index. The result is that these granules cannot be more perfectly resolved with an oil immersion objective than with a water immersion one, a point that is rarely recognised. I am not mentioning this in any critical sense, but am drawing attention to an inherent difficulty incidental to a particularly interesting and carefully conducted research.

Under such conditions there is no remedy that can be applied, as the efforts to remove the objections that can be raised, and with good reason, against ordinary methods of fixation have in themselves brought unexpected troubles. I have had the privilege of discussing this work with Mr. Stoughton, and am pleased to say that there is every indication that his observations are accurate. My own efforts to determine the structure of living bacteria by means of ultra-violet light are in close enough agreement to be regarded as confirmatory.

There is another point that I might well mention here—that lightly-stained preparations or unstained ones in which contrast is slight, are more difficult to resolve than those in which there is great contrast. Conrady drew attention to this many years ago, and there is no doubt that it is true, as in some exceptional cases it becomes quite evident. It seems clear that delicate translucent structures are less tolerant of aberrations in the objective, and that the Rayleigh tolerance of $1/4\lambda$ cannot with safety be departed from, while objects with great contrast will allow of as much as $1/2\lambda$. One can hardly elaborate this point further, but it is worth remembering, particularly at present, when the structure and observation of living organisms is of more interest than stained preparations, although it is admitted that only a keen observer will appreciate such differences.

Another example of the association of visibility and resolution can be cited in which limits are not so easily defined. In no branch of medical research has staining technique reached a higher standard than in neuropathology. Almost perfect visibility of nerve fibres is secured, and the mounting conditions are such that the utmost resolution is attainable. But limits

are reached in an often unlooked-for direction. Through the kindness of Prof. W. Bulloch, F.R.S., I am able to show you photographs of an unusually beautiful preparation. It is known as Auerbach's plexus, and is a great nerve sheath which lies between the outer or longitudinal and the inner or transverse muscular layers of the intestine, as shown on a drawing kindly supplied to me by Prof. Bulloch. This plexus can be detached in thin layers, and it is a stained preparation of such a layer that I am showing. It is stained by Bielchowsky's silver method (see Bolles-Lee "Microtomist's

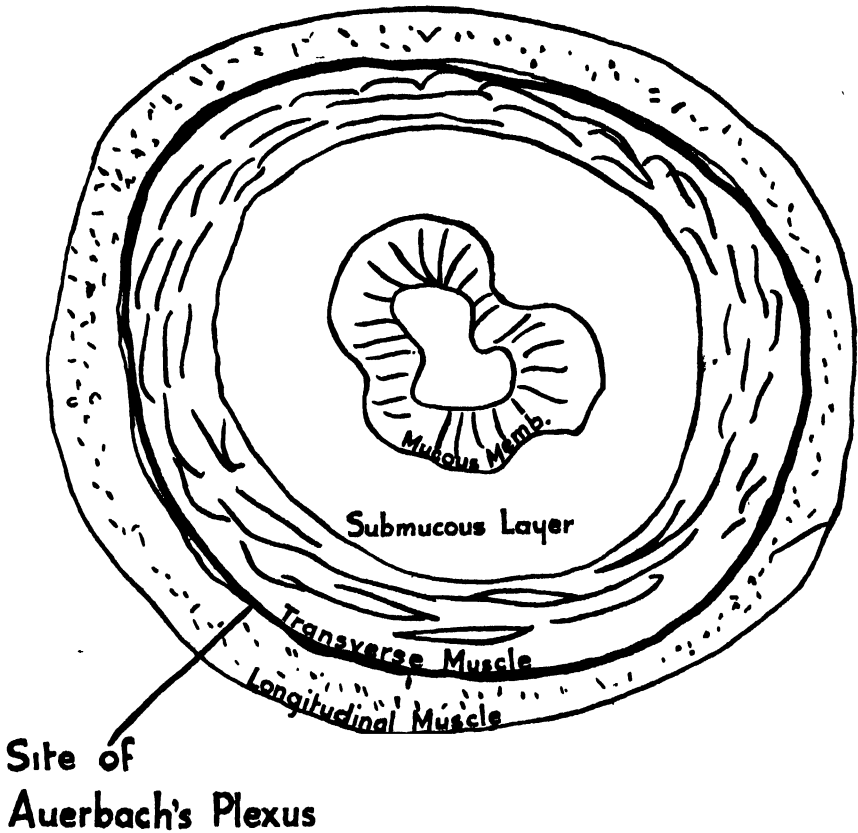


FIG. 2.

Vade-Mecum"), which is a silver impregnation, or more accurately, perhaps, a silver deposition process. The four photographs shown are at successively higher magnifications—fig. 5 \times 68, fig. 6 \times 280, fig. 7 \times 1250, fig. 8 \times 2000. Certainly the first two are wonderful demonstrations of structure—it would be difficult to imagine anything better—but fig. 7 begins to show some irregularity of the nerve fibrils, while in fig. 8 it is quite evident. The latter has been photographed with 2 mm. apochromatic objective, 1.40 N.A., and with a blue-green colour screen selected, not merely to give contrast, but to use that portion of the spectrum for which the objective was best corrected.

The result shows that to achieve such perfect visibility it has been necessary to deposit silver on these nerve fibrils in sufficient quantity and in such a state of division that resolution is obtained, not of the ultimate structure, but of the deposited silver. I am sure you will agree that we are much indebted to Prof. Bulloch for the opportunity he has given us to see these structures, prepared and stained by him with such skill, particularly as I believe that these have not hitherto been published elsewhere. Another example of the same order is to be seen in figs. 9 and 10, typhoid flagella stained by Van Ermengem's well-known method. The organisms are fixed for a few minutes in osmic acid and tannin, put into nitrate of silver, then for a few seconds in gallic acid tannin and acetate of soda, then back into nitrate of silver, washed and mounted in Canada balsam. In a successful preparation—the process is uncertain in most workers' hands—the organism and the flagellæ become quite opaque, so visibility is perfect, and the method of mounting admits of the use of the highest N.A. objectives. The magnification is, fig. 9 $\times 1250$, fig. 10 $\times 2000$, the former showing the granular silver deposited on both bacillus and its flagella, while the latter is obviously photographed at too high a magnification for good resolution, but it does accentuate the granularity of the image. The apparent breaks in the flagella are entirely due to failure of the silver to deposit equally along the entire length, but the course of the filament can be traced. The reason for showing fig. 10 is to draw attention to another point that the photograph demonstrates very well. In preparations made by this staining method there is always a certain amount of silver in the ground, presumably due to colloidal material on which silver has been deposited. Such granular material is constantly to be seen in the ground of preparations made from fluid culture media, and it occurs whether the material is from an active culture or from an uninoculated tube. These granules are of widely varying sizes, from resolvable bodies to those that are not merely unresolvable, but are at the limits of visibility for objects illuminated by transmitted light and by a wide cone of illumination. As all these particles are on the surface of the object slide, it is possible to regard them as being focusable—they do, in fact, lie in one plane. Careful observation will enable one to see the type of image as the particles become smaller. The large ones are resolved; they are quite black, with sharp edges and no detectable diffraction rings. As they get smaller, the edge becomes less sharp, until a stage is reached where a mere ghost-like image with no definite edge is just seen. This stage represents the limit of visibility for such an object; it may, in fact, represent the limit for objects seen by transmitted light, as no conditions can be conceived that are more favourable.

You will hardly expect me to do other than refer to some examples within my own experience, particularly in the use of ultra-violet light. I have already drawn the attention of the Society to some of the advances made by myself, with the valued help and loyal co-operation of my laboratory staff, particularly in the direction of the application of dark-ground methods



Fig. 5



Fig. 6



Fig. 7



Fig. 8

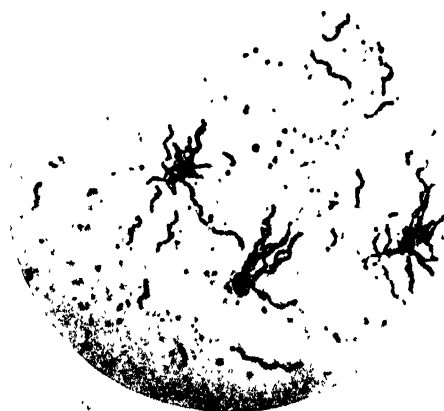


Fig. 9

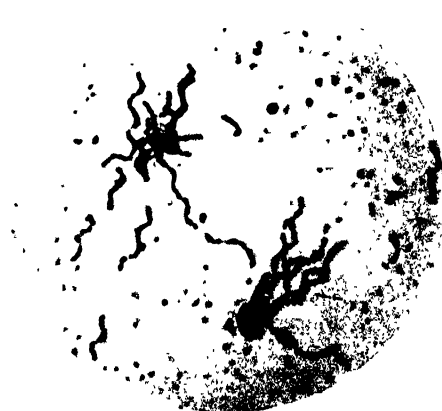


Fig. 10

to this work. In this case the extent to which visibility is obtainable is dependent on the optical properties of the material under observation and of the wave-length of the light employed. No artificial method of increasing visibility is available, nor does it appear to be likely or even desirable that such will be devised. The effect of a relatively small change of wave-length on visibility is greater than one is accustomed to in visual work—in fact, relative dispersion changes so considerably that an object in water may show well in ultra-violet, but be invisible in visual light. If it is possible to use glycerine and water as a mounting medium—although, in fact, it rarely is satisfactory for living objects of any sort—then the conditions of complete homogeneity are secured, and the fullest resolution is obtainable. The great practical difficulty in ultra-violet dark-ground work is to obtain a photograph in a short time; long exposure to any invisible radiations is to be avoided. I indicated a year ago that we were experimenting with a type of dark-ground illuminator in which the whole image of the radiant was utilised, instead of only a part of it transmitted through an annular opening, as in the usual reflecting type. Such an illuminator would not be of particular advantage for visual work, although I think it may well have some applications, but it has proved to be invaluable for work in the ultra-violet. I regret that it will be impracticable to publish any results in the Journal with this address, owing to the great difficulty of reproducing such images satisfactorily. It is of interest to see the structure that can be revealed in bacteria, going from the large ones to the smallest that have been demonstrated by staining methods. The following are representative :—

Bacillus megatherium.
 „ *mycoides.*
 „ *coli communis.*
Micrococcus pyrogenes aureus.
Bacillus prodigiosus.
 „ *bronchisepticus.*

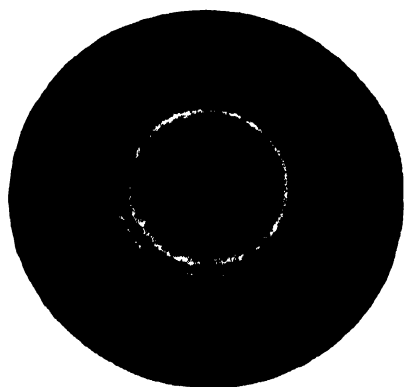
The last two are among the smallest known, the former being used as a test organism in filtration experiments, the latter the smallest in diameter hitherto shown by staining methods. Perhaps the greatest advantage hitherto realised by our new type of illuminator is that it is possible to use with it quartz objectives of the highest available aperture. This very advantage brings with it some accompanying difficulties: quite unexpected variations in visibility become evident, elements of structure that are obvious enough at one working aperture are less evident or even invisible at another, even a higher, aperture. It must be remembered that a micro-organism is a sphere or a cylinder, usually highly refractile, and illumination of the contents of such an object is not easy. The extraneous medium approximates to water in refractive index, the cell plasma is not much more refractile than water, and the contained granules vary between quite unknown limits.

Further, the latter are of varying sizes, and, contrary to any preconceived notions, are not all spherical. In the larger organisms the difficulty of resolving the cell contents is considerable, and, in cases, impossible of achievement, owing to the amount of granular material in the cell. Thus, in *B. megatherium* sometimes it is possible, particularly in young cultures, to resolve successfully the cell contents, but at other times it cannot be achieved. Increase of N.A. in the objective implies less depth of focus, and it does seem that at some angles of illumination too much light is reflected by the cell membrane to allow of satisfactory illumination of the cell contents. In smaller organisms, particularly the micrococci, the cell wall appears to be thicker or more highly refractile, or both, with the result that contained granules often cannot be seen, although there is no reason to expect that they are non-existent. In the smallest of the bacteria, the two last, for instance, that I have mentioned, structure can be demonstrated without difficulty by the ultra-violet dark-ground method; the cell wall appears to be thinner—at least, in the direction of its length—but the rounded ends are apparently thickened.

Experiments have been made, with interesting results in some cases, with combined dark-ground and transmitted light illumination. The available N.A. of the objective is slightly greater than that necessary to secure a true dark-ground image; visibility is reduced, the reduction being controlled to suit any particular object, but in the resulting image the full effect of the increased working N.A. is evident. Whether this method will be of widespread interest is difficult to say, but with some objects it has proved valuable—there is a plasticity about the image that is at least fascinating.

In another direction our new appliance has proved to be of unexpected value. Long ago I brought before this Society some applications of ultra-violet light in which a fluorescent image is seen and structures differentiated when an object is illuminated with ultra-violet light, but observed by means of an ordinary glass objective. Some objects are extremely beautiful when seen in this way; but, owing to the difficulty of illumination, only low powers could be used, the intrinsic brilliancy of any illuminant was not high enough. I did, a year ago, show one photograph of bacteria, but it took a long exposure to obtain a result. With our new illuminator, even although it is still in an experimental and, it is hoped, a transitional stage, it is possible to observe with ease, not only a bacillus, but the granular contents of the cell. The image is one of amazing beauty, and it is well to remind you that it is a truly self-luminous object, and that there is no definite phase-relationship between the rays emanating from its elements of structure. Yet the resolution attainable is perfect: every detail can be seen to perfection, and some details can be seen that are not detectable by other methods.

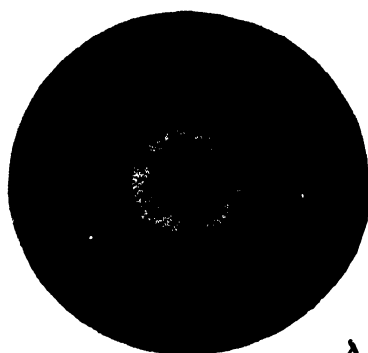
It is often questioned whether anything new has been demonstrated by the use of ultra-violet light, anything that cannot be seen and resolved by ordinary methods. It may be of interest to say that an unquestionable



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-1.0
-0.5
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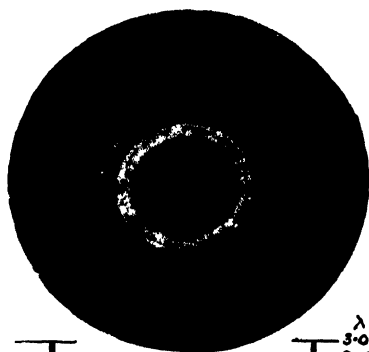
$N_D = 1.5190$
 $\lambda = 4359 \text{ \AA}$

Fig. 2a



$N_D = 1.5180$
 $\lambda = 4359 \text{ \AA}$

Fig. 2b



$N_D = 1.5164$
 $\lambda = 4359 \text{ \AA}$

Fig. 2c

example has been found quite recently. In the search for filtrable viruses by microscopic means, many appearances observed have been difficult to explain, and among these the changes that sometimes occur in uninoculated culture tubes have been most puzzling. As the result of prolonged effort, a living organism has been photographed by the ultra-violet dark-ground method that cannot be identified by visual dark-ground, and that is indistinguishable from non-living granular material by any staining method. It is too small to be resolved by an ordinary microscope, but it is just within the theoretical competence of the best quartz objective in my possession. At present some cultural difficulties have to be overcome, but these are not insuperable, and it is hoped to give a fuller account of its biological characteristics at a later date. At present the fact that such a small body can be identified is the main point of interest. I might spend much more time and go into many points hitherto untouched, but the time available makes that impossible. I should like to remind you that the difference between the theoretical possibilities of resolution and practical achievement are considerable. The precise limits of resolution may be arrived at when a regularly spaced black-and-white object, either in lines or squares, is being considered, but these conditions are never met in practical microscopy. That visibility of an ideal order may be pleasant to contemplate in theory, but that in practice anything approaching that state is rarely found. I know of no pronouncement on the subject that is clearer or more convincing than that by J. J. Lister on "The Limit of Defining Power," republished in our Journal under the able editorship of Prof. A. E. Conrady, in which he says as follows:—

"There is another mode of considering defining power which, though it may not admit of such positive measurements as the separation of squares or stripes furnishes, requires to be adverted to, namely, that which regards distinctness of outline and the extreme limit to the visibility of a single object.

"The smallest angle under which I could detect the existence of a black square on a white ground with the unassisted eye in daylight was when its side subtended 33 seconds, which nearly agrees with Sir W. Herschel's and Mayer's observations, and is about half the angle at which separation vanishes in a series of stripes or a chequer; but viewed through a circular aperture of 0.02 in. and under, and in the microscope, it is just visible as far as to one-third of that angle or $\frac{0.000007}{a}$ radius being unity. An equal white

square on a very black ground may be detected at more than double the distance of a black on white, though its limit has been stated to be the same. Indeed, the angle under which a bright object may be seen diminishes indefinitely with the increase of its intensity and its opposition to the space surrounding it.

"Merely to ascertain the existence of a something is, however, generally of little value unless we can also distinguish its figure, and here our vision is

confined to much narrower limits. Sir W. Herschel determined that a square area could not be distinguished from an equal circular one with the naked eye till the latter subtended 2 feet 17 inches, and I found that it must be still larger to have its form well defined. The black and white squares composing a chequer could, when viewed through small circular apertures or in the microscope, be seen to be of the same size and to touch at their corners, till brought to within half the vanishing distance of the pattern, i.e., to a distance when the side of a square is at an angle of about $\frac{0.00005}{a}$.

“In various trials made by me, the light beyond the green, towards the violet end of the spectrum, was found too faint to give that increase of definition that might be expected from it, except when the solar beam was thrown on the prism, and although the blue rays then produced an effect of singular beauty, they were, like the sun’s light in general, so accompanied with fringes as to prevent their showing objects in the microscope with distinctness and certainty.”

I doubt if it is possible to put the problem in plainer language. It is reassuring to know that there are directions in which efforts are being made to make microscopy a more exact branch of science, to enable it to conform to the general tendency for higher accuracy. It is not the purpose of an address of this kind to give detailed accounts of researches still in progress, but there is no harm in indicating the lines along which such work is proceeding. In my own laboratory the work that is being done by my colleague, Mr. Smiles, is an example, and I will just draw attention to one or two points that have recently been demonstrated, leaving the main results of his work, on the use of the interferometer for testing microscope objectives, to be communicated to this Society on another occasion. The instrument used for the experiments has been made by Messrs. A. Hilger, and is a modification of their well-known lens testing interferometer as designed by Mr. F. Twyman. Its construction and use for the testing of large lenses and optical surfaces are well known, a good deal has been done with it in various directions, but its application to microscope objectives is more difficult, and has not yet received much attention. Mr. Smiles is, however, making progress with the confident hope that it will be of service in the production of quartz objectives for ultra-violet work, where higher accuracy is so important. Let me therefore give you two simple instances of the effect on the actual working of an objective under conditions that are of everyday occurrence. We are not here concerned with the defects which may be present in microscope object-glasses, and will therefore assume that they are perfect, but that the conditions under which they are used may vary. For example, what will be the effect of a change in the refractive index of the immersion medium upon the image? Such an effect may be estimated with accuracy by means of interferograms such as those I am showing.

Since microscope object-glasses are built up of components having spherical surfaces, all the rays from an object point leaving the back aperture

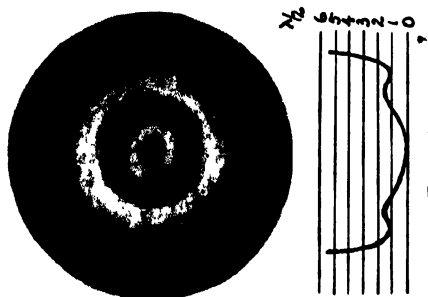


Fig. 3c

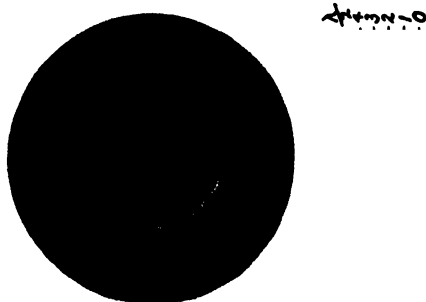


Fig. 3

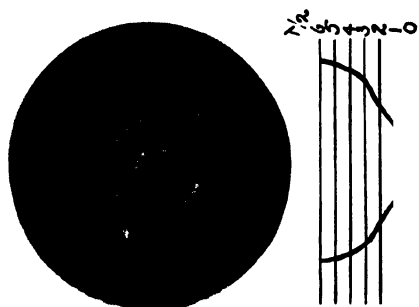


Fig. 3

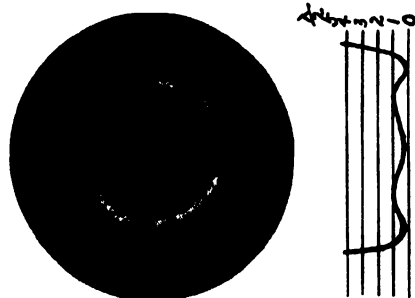


Fig. 3e

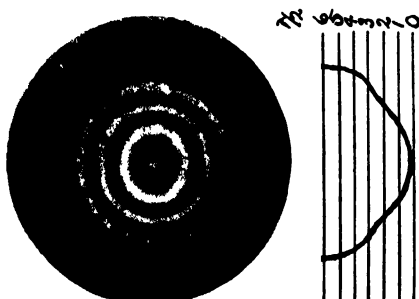


Fig. 3a



Fig. 3d

do not intersect on the axis at a single point, and since these rays are normals to the emerging wave surface, it follows that the wave surface is not truly spherical. The condition that the deviation of the actual wave surface from the ideal spherical form shall not be sufficient to produce any observable deterioration of the image has been laid down by the late Lord Rayleigh, who stated that the difference between the longest and shortest optical paths to the focus shall not exceed a quarter of a wave-length.

By means of an interferometer we may determine the aperture over which this condition is fulfilled, and how the wave surfaces change when the refractive index of the immersion medium is changed. Any alteration in the form

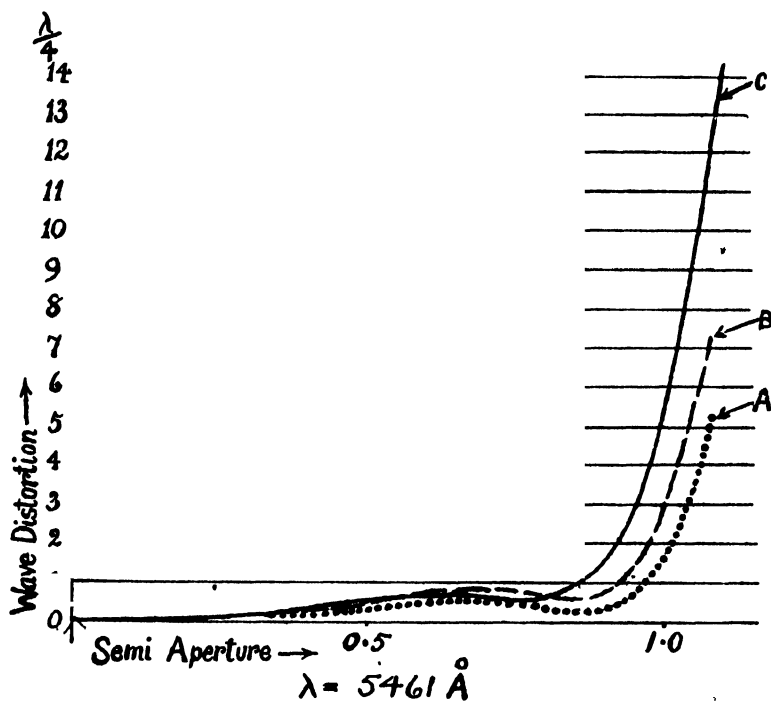


FIG. 1.

of the wave surfaces would, in general, alter the diameter of the aperture over which the Rayleigh condition is fulfilled, being a maximum for some particular value, and diminishing for greater and lesser values.

To illustrate the above, fig. 1 shows the distortion of the wave front produced by a 8 mm. oil immersion lens of N.A. = 1.40 when three different samples of immersion media are used. Curve A represents the distortion when the refractive index of the medium for the D line is 1.5190, Curve B that for a value of 1.5180, and Curve C that for a value of 1.5164. The last value may appear ridiculously low, but it is, nevertheless, the value obtained by measuring a certain commercial sample which is at present on

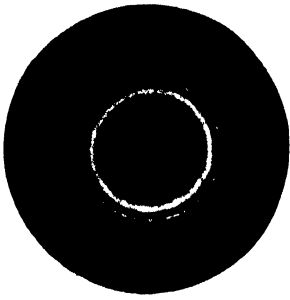
the market. All the examples shown are from such commercial samples selected at random from different microscope makers.

In each case, if the marginal zones of the lens where the distortion of the wave surface exceeds the Rayleigh condition were used, they would have a detrimental effect upon the image, with consequent reduction of resolution below that which could be obtained if these zones were not used. It is therefore obvious from the curves that in order to obtain the best possible image the aperture must be reduced when the index of the immersion medium is reduced. In each case the tube-length and cover-glass thickness remained constant.

In figs. 2*a*, *b*, *c*, interferograms, with their accompanying wave-distortion curves, show the effect of these index values with light of wave-length 4859 \AA . The tube-length and cover-glass thickness were the same as in the preceding case. It is interesting to note that when $\lambda = 5461 \text{ \AA}$, the aperture satisfying the Rayleigh condition is greatest in the three cases when $N_0 = 1.5190$, whereas when $\lambda = 4859 \text{ \AA}$, the maximum aperture occurs somewhere about the value $N_0 1.5180$, and that it has been considerably reduced. Further, for the shorter wave-length the variation in the distortion of the wave surface has increased very considerably. It follows that when the lens is used in this part of the spectrum, either visually or photographically, the aperture should be very considerably reduced in order to make the best possible use of it.

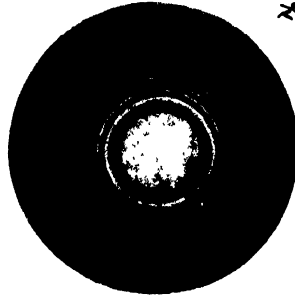
The interferograms (fig. 3*a* to 3*l*) show another point of practical value—how the wave surfaces vary when the objective under test is moved relative to the object plane by intervals of 0.0002 mm . Since the object plane on the interferometer is a silvered surface, the curves representing the distortion of the wave surfaces are practically identical with those of the waves leaving the back aperture when an axial point source is moved along the axis through intervals of 0.0004 mm . To illustrate this, let *MM* (fig. 4) be the silvered surface, and let $P_1 O_1 P_1$ be the boundary of spherical waves converging from the front aperture of the objective on the point O_1 on the surface of the mirror. At the point O'_1 the waves will be reflected and will re-enter the objective as though O_1 were a point source. Let the objective be moved towards the mirror through a distance δ , so that the waves converge on O_2 a distance δ behind the mirror. They will, however, be reflected back to a point O'_2 , a distance of δ in front of the mirror. From this point the spherical waves will diverge to re-enter the lens. Since the lens has been moved towards the mirror by a distance δ , and the point O'_2 is a distance δ in front of the mirror, the equivalent object distance has been reduced by 2δ .

The best object position is that represented by fig. 3*h*, where the aperture over which the Rayleigh condition is fulfilled is a maximum. On either side of this position the aperture over which there is fulfilment of this condition progressively decreases. Since there are two limiting positions for any smaller aperture satisfying the above conditions—on each side of the maximum—



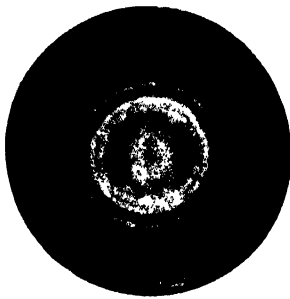
1/2
5
4
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q.3



1/2
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q.3



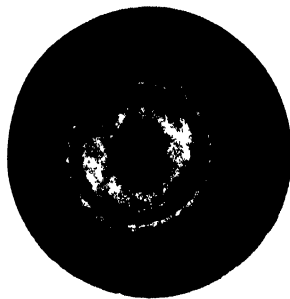
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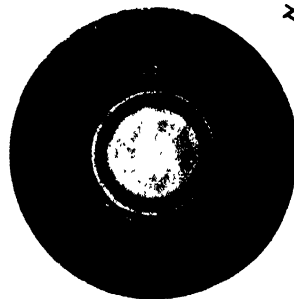
1/2
5
4
3
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Fig.3 k



1/2
5
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2
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Fig.3 q



1/2
5
4
3
2
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q.3.

the distance between them will be the focal depth for that aperture, and this will increase or diminish as the aperture is reduced or increased respectively.

In the present case, owing to the marginal zones producing heavy distortion, the focal depth for the maximum aperture satisfying the Rayleigh condition may be considerably less than if the lens had been specially designed to work at that aperture. It is clear that if full advantage is taken of the Rayleigh condition when designing a lens, it may not compare favourably with one of the same aperture in which the difference between the maximum and minimum paths is, say, $1/10\lambda$, and when the depth of the object is equal to the focal depth of the latter.

Both these effects are of interest in practical microscopy and both influence the results obtained. That there are such differences in immersion media is surprising, but the effect on resolution is evident. In the use of oil

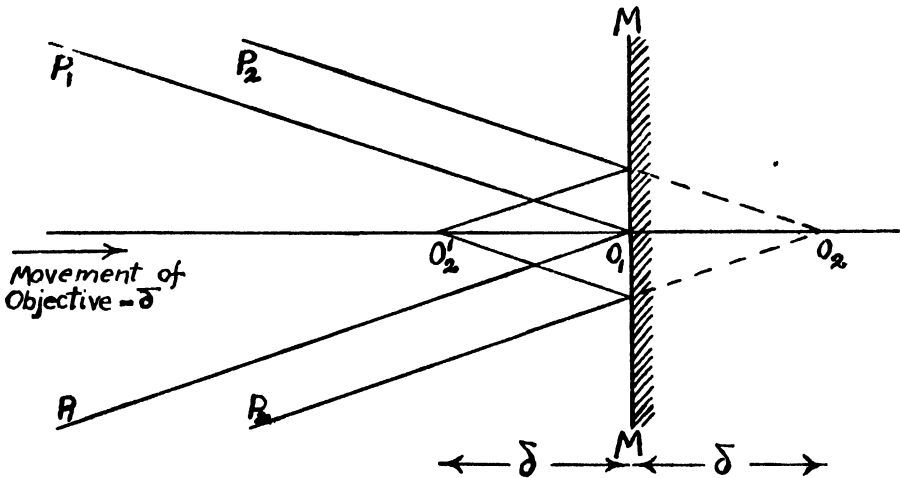


FIG. 4.

immersion objectives for dark-ground work, another defect has on occasions been in evidence. It was noticed that there was difficulty in getting an image free from glare or scattering in cases where the object itself presented no unusual difficulty. This was ultimately traced to the immersion oil, which contained so much matter in suspension that the image was seriously affected. It will readily be understood that in such a case visibility of the object might be seriously reduced, so much of the light leaving the object being scattered before it reached the objective. Under such conditions resolution must also suffer. It is a primary essential that the light entering the objective should be only that arising from the object.

It would not be difficult to increase the number of examples of conditions that in practice do vitally affect the attainable results, but the limitations of time will not allow more. The precise effect of visibility on resolution must be determined for each set of conditions as they arise ; no simple

mathematical relation will satisfy them all. It is, perhaps, well to remember that the probability of the attainment of the utmost theoretical resolution is remote, and that among the many factors contributing to this, no single one is more powerful than the failure to achieve satisfactory visibility.

Some fantastic claims have been made in connection with the identification of very small organisms, claims that could not be substantiated on any grounds whatever. Unfortunately, they do result in a feeling of uncertainty in the minds of some of those who read them, and it is with the hope of removing some of these uncertainties that I have ventured to address you on this subject.

I should like, in conclusion, very briefly to refer to the more domestic affairs of this Society. During the two years in which I have, for the second time, had the privilege of being your President, the responsible officers have had some anxieties that might well be regarded as unusual. These have been surmounted, with the result that this Society is now in a stronger position than it has been for many years—it may even be, stronger than it has been for a generation. It is no unusual experience to find that difficulties, resolutely faced and handled to the best of one's ability, are blessings in disguise; it is perhaps advisable to regard such difficulties as definite incentives to greater effort. In our own case, this seems to be the lesson intended for us, and, if I may say so, I think we have profited by it. We have had some good fortune. Particularly are we fortunate in again having a man with scientific attainments in active day-to-day charge of the affairs of the Society. If I am any judge of intentions or, even more important, of ambitions, then Dr. Tierney will prove a greater asset in the future than he has been in the immediate past, and that is saying a good deal. I should, however, like to remind the Fellows that no one man can do everything—in fact, it is not fair to expect him to do more than his share. Within my memory this Society has deteriorated in one particular—the Fellows no longer take that active part in, or contribute to, the proceedings as they once did. Exhibits of any sort are less numerous; there is less inclination to show to others for the purpose of obtaining help and criticism. This was at one time an outstanding feature of our Society, and I should be delighted to see a revival that would, I am sure, add much to the interest of the meetings. It is often thought that anything shown must be of unusual interest or must demonstrate a hitherto unobserved feature. This does appear to me to be entirely erroneous. Do we not all get much pleasure and profit from the observation of structures with which we are familiar, but which acquire a new interest when shown by other people by methods differing even only in detail from our own? There is enough for us all to do. Let us, then, remember that the term "Fellowship" means not only the regular payment of a subscription, but that it imposes on us all the obligation to contribute something for the general good.

II.—FURTHER OBSERVATIONS ON PULMONARY ASBESTOSIS, WITH SPECIAL REFERENCE TO ASBESTOS DUST AND THE CURIOUS BODIES FOUND IN THE LUNGS.

By W. E. COOKE, M.D., F.R.C.P., F.R.M.S., and C. F. HILL,
M.Inst.M.M., A.Inst.P., F.R.M.S.

(Read January 15, 1930.)

THREE PLATES.

In the Journal of the Royal Microscopical Society (1927) we quoted historical references to the manufacture of asbestos and gave the chemical and microscopical characters of chrysotile and the clinical and pathological findings in the first published case of pulmonary asbestosis. The case was the subject of a paper in the British Medical Journal (1924), but previous to this, asbestos had been suspected to be a cause of pulmonary fibrosis. The late Dr. H. Montague Murray, giving evidence before the Departmental Committee on Industrial Diseases in 1906, referred to a case of pulmonary fibrosis of obscure origin that had been under his care at the Charing Cross Hospital. The lungs of this case were examined in 1900, and Dr. Murray stated that sections showed the presence of asbestos spicules.

The history of pulmonary asbestosis may be said, then, to date from the year A.D. 1900, although the manufacture of asbestos into cloth had been an industry 2,500 years before that time.

ASBESTOS AND ASBESTOS DUST.

Asbestos belongs to the pyroxene or hornblende group of minerals—igneous rocks which were originally silicate solutions, compounds of silicic acid with earthy bases. Under certain physico-chemico conditions, hornblende and serpentine pass into fibrous varieties, and are then given the technical name “asbestos.”

The infinite varieties of asbestos differ in their chemical composition and physical characters, but we propose to confine ourselves to one type only, Canadian chrysotile, the asbestos in which our case worked.

The average composition of Canadian chrysotile is:—

Silica	..	..	..	..	..	40·87 p.c.
Magnesia	..	..	..	..	..	41·50 ..
Ferrous oxide	..	..	..	..	..	2·81 „
Alumina	..	..	..	..	..	0·90 „
Water	..	..	..	..	..	18·55 „

The iron content may be important. It will be interesting to see whether the effects of the iron-free dusts of some Italian, Arizona, Finland, and Chinese asbestos are the same as in chrysotile workers.

Microscopically (fig. 1) chrysotile fibre consists of colourless refractile translucent strands, but intermingled with the fibre are masses of black angular particles, brown particles of all shades from light yellowish-brown to deep golden brown, and particles the colour of sapphire blue.

The dust generated during the process of manufacture consists of fragments of fibre and slender translucent spicules split off from it. These spicules are of varying lengths and thicknesses, some of them being beyond the limits of resolution and ultra-microscopic. The dust contains also the black, brown and blue fragments seen in the raw asbestos (coloured plate fig. 1). The colourless translucent particles and the brown and blue particles of the dust are refractile by polarised light. The black particles are biotite and magnetite and do not transmit light. These iron-containing minerals are responsible for the varying percentages of iron in different specimens of asbestos, and, as would be expected, the dust containing the greater number of black particles has the greater iron content. Microscopically, the finished woven article contains very few black particles, whereas the dust from the carding room is grey in appearance and contains them in abundance.

The iron content of chrysotile, the finished article, and the dust is as follows :—

Chrysotile : iron (as ferrous oxide)	..	2.81	p.c.
Finished article : iron (as ferrous oxide)	0.1	„	
Dust from carding room : iron (as ferrous oxide)	.. .. .	18.4	„

ASBESTOS DUST IN THE LUNGS.

Sections of lung, and the results of digestion of the lung with trypsin, show an enormous amount of fine black granular dust, much of which is carbonaceous. In addition, there are two striking features.

The first is the almost complete absence of the very fine translucent spicules of fibre which make up the great proportion of asbestos dust in factories. This point will be referred to later.

The second feature is the presence of large fragments varying in length from 5 to 360 microns (figs. 2 and 3). They are found in fibrotic and necrotic areas, singly and in groups. The particles are so large—masses of them are seen in some sections—that they must have occluded small bronchi, and resulted in fibrosis of the surrounding area with, later, necrosis.

Comparing these particles in the lung with those found in asbestos dust, the close resemblance in sizes, shapes, and colours is apparent (coloured plate fig. 2). There are the same black, blue, brown and translucent fragments. In fact, it is easy to take each single particle from the lung and immediately

PARTICLES OF CHRYSOLITE DUST.
X 150 DIAMETERS.

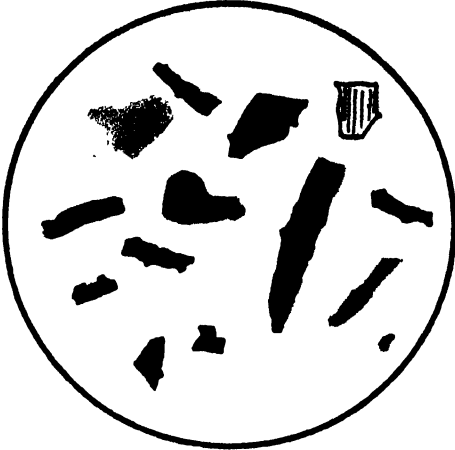


FIG. 1.

PARTICLES FROM LUNG
X 150 DIAMETERS

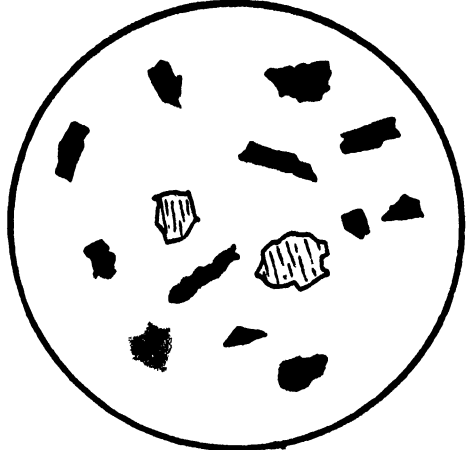


FIG. 2.

PARTICLES OF ASBESTOS DUST
IN LUNG IN ONE FIELD. X.400 DIAMETERS.



FIG. 3.

find its brother in a slide made from the dust. Coloured plate fig. 8 shows the variety of coloured particles in one microscopic field in a section through a necrotic area of lung.

The question we had to answer with regard to the 1924 case was, "Did the deceased's occupation cause or contribute to her death?" Upon the foregoing evidence one answer only was possible.

The finding of large particles of asbestos dust is in striking contrast to any other fibrotic lung condition. In silicosis the fibrosis is largely due to the chemical action of free silica (SiO_2), the average size of the particle being only 2 microns. It would appear that in silicosis the action of the silica particles is chemical rather than mechanical, whilst in asbestosis the fibrosis is due to mechanical rather than chemical injury.

THE CURIOUS BODIES FOUND IN PULMONARY ASBESTOSIS.

In addition to the fine granular dust and larger fragments of asbestos, sections of the lungs show curious bodies, some of which are illustrated in figs. 4 to 10. They are found in alveoli, bronchioles, fibrous and necrotic areas and in phagocytes in sections of both lungs. If a portion of lung be teased and extracted with water or digested with trypsin these bodies are seen in myriads. The larger bodies measure from 20 to 100 microns or more in length, are of a golden brown colour, and some are shaped as seen in the illustrations. They may have single clubbed ends or appear as elongated dumb-bells, some as filaments, while others suggest a series of discs. Single coccal and spore-like forms, and aggregations of these, and streptococcal forms are not uncommon. The colour varies in the smaller types from a very pale yellow to a yellowish-brown. The bodies do not stain with any of the aniline dyes, but, in chrysotile workers, give the Prussian blue reaction for iron in varying degrees of intensity. These curious bodies have been found in every necropsy in pulmonary asbestosis. We have examined sections of the lungs in Dr. Murray's case, and they are present in the characteristic forms seen in the more recent cases.

The problems we have to decide are, firstly, what the bodies are, and, secondly, whether they are diagnostic of asbestosis. You will remember that in 1927 opinions were equally divided as to whether the bodies were fungoid or not. Further work has elucidated the problem.

During the process of digestion of the lungs with trypsin it was found that if the specific gravity was kept about 1070, the black dust and larger fragments of asbestos, as well as the partially digested lung tissue, sank to the bottom of the tube. By decanting the apparently clear supernatant liquid, centrifugalising, neutralising, and washing the deposit, the curious bodies could be obtained in a pure state. This was done, and sufficient material for X-ray examination obtained. The bodies were attached to a hair with gum and subjected to a seven hours' exposure by Prof. Bragg's method. If the bodies were mineral the X-ray film would

have shown a definite translatable atomic pattern. The films, however, did not do so, and we were then able to exclude the suggestion that the bodies were altered asbestos fibre. The result definitely pointed to the greater proportion of their composition being of non-mineral origin.

The bulk of the curious bodies is soluble in strong acids and alkalis, and if solution be observed under dark-ground illumination, their bases are seen as extremely fine spicules, some of which by transmitted light would probably be invisible.

Under a dissecting microscope it is possible partially to fracture the larger bodies and to show a central fine core of asbestos, as in figs. 6 and 7.

We have mentioned that the greater portion of asbestos dust consists of slender translucent fibres. In sections and extracts of the lungs there is a remarkable paucity of these fine spicules. The end-results of digestion show the fine granular dust and the large black, blue, and brown particles (coloured plate fig. 2), and what appear to be pieces of quartz. Relatively few fine spicules are found, but curious bodies of all descriptions are present in enormous numbers.

All these facts lead us to imagine the bodies to consist of central nuclei of asbestos spicules upon which colloidal aggregates of blood proteins, plus, possibly, soluble fractions of asbestos, and in the case of chrysotile workers iron salt, have been adsorbed and moulded by currents in the bronchi and alveoli.

Occasionally biotite fragments into fine black spicules, and if our reasoning be correct, some at least of the millions of curious bodies should show a central core of this mineral. Figs. 8, 9 and 10 illustrate this condition and are, we think, the final proof of our theory.

The method of formation would appear to be as follows. The fine spicules of asbestos cause, by mechanical action on the bronchioles and alveoli, either minute extravasations of whole blood or serious exudates which envelop them. Solution of any soluble fraction of asbestos takes place. The total amount of asbestos that is soluble must be extremely small, as proved by the X-ray pattern of the curious bodies, but in the case of chrysotile workers some solution is suggested by the free iron reaction. We must remember, however, that the Prussian blue reaction may be due to the iron of hæmoglobin. Any surface in contact with a colloidal solution may act as an adsorbent, and in the present case the fine spicules must be considered to do so. Interaction between the soluble fraction of chrysotile and plasma proteins takes place, syneurisis occurs and with the loss of water the adsorption is rendered irreversible. The adsorbent is permanently ensheathed with stable colloidal aggregates which become moulded into the familiar shapes by alveolar and bronchial currents.

Some support of this is adduced by the fact that micro-organisms adsorb colloidal material in the presence of blood serum and colloidal asbestos. Staphylococci so treated appear as large yellowish-brown discs, and in the process their property of staining with aniline dyes is lost. The organisms



FIG. 1.



FIG. 2.

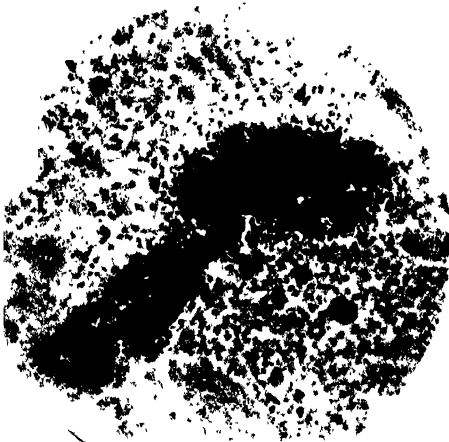


FIG. 3.



FIG. 4.



FIG. 5.



FIG. 8.

FIG. 6.

FIG. 9.

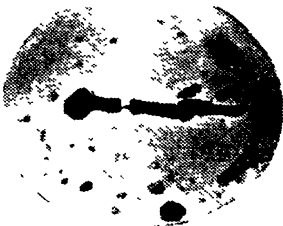


FIG. 7.



FIG. 10.

coalesce and form masses, and we think it probable that some of the coccal and spore-like forms of the curious bodies are similar organisms.

Finally, the answer to our second question must be found. "Are the curious bodies diagnostic of pulmonary asbestosis?" Asbestos is unique among the minerals in being fibrous, and the dust generated during the manufacturing process is also unique. As can be imagined from the formation of the curious bodies, there is no reason why any fine spicule of mineral should not have colloidal matter deposited around it and become moulded into a curious body. But, as no other mineral dust is fibrous, this occurrence must be so rare as to be negligible from a diagnostic point of view. The conditions which apparently must obtain for the formation of the curious bodies are the presence of plasma proteins and fine spicules of insoluble or difficultly soluble material. These conditions are ideally found in asbestos workers, and for this reason we believe the curious bodies, if found in any numbers, are pathognomonic of pulmonary asbestosis.

REFERENCES.

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COOKE, W. E., and HILL, C. F.—*J. Roy. Micr. Soc.*, 1927, **47**, 232.

DESCRIPTION OF FIGURES.

- Fig. 1.—Asbestos fibre showing translucent strands and angular particle. $\times 150$.
Fig. 2.—Asbestos particles in a fibrotic area of lung. $\times 150$.
Fig. 3.—Large fragment of asbestos, 360 microns in length, in a necrotic area of lung. $\times 150$.
Figs. 4 and 5.—Curious bodies in lung sections. $\times 400$.
Figs. 6 and 7.—Curious bodies showing the colloidal aggregates separated, mechanically, from the slender filaments of asbestos fibre on which they are adsorbed. $\times 400$.
Figs. 8, 9 and 10.—Curious bodies, the nuclei of which consist of spicules of biotite. $\times 400$.
In fig. 10 the globular ends of the curious body have become detached, leaving the spicule of biotite bare.

COLOURED PLATE.

- Fig. 1.—Particles of chrysotile dust showing black, blue, and brown fragments. $\times 150$.
Fig. 2.—Particles of chrysotile dust obtained by digestion of lung with trypsin. $\times 150$.
Fig. 3.—Particles of chrysotile dust in one microscopic field, in a section through a necrotic area of lung. $\times 400$.

Figs. 6, 7, 8, 9 and 10 are reproduced by kind permission of the Editor of the *British Medical Journal*.

III.—CELL NOMENCLATURE.*

By J. BRONTË GATENBY, Trinity College, Dublin University.

(Read February 20, 1930.)

TWO TEXT-FIGURES.

THE non-cytologist studying the literature on the cytoplasm will soon come to the conclusion that the majority of the Italian and Spanish workers figure the Golgi apparatus as a net-like structure, while most British, German, and American observers draw small crescentic rods not necessarily running together to form a reticulum. If some of the literature emanating from France is examined, it will be noticed that instead of rods, crescents, cups, or nets, simple globules are figured in the "Golgi region." The older workers found nothing except a centrosphere and centrosome in this part of the cell.

These various interpretations are all, in a sense, correct. The truth is that in the region of the Golgi apparatus, in its discrete and juxta-nuclear form, there is a complicated structure consisting usually of three distinct parts. The examples which best reveal these structures are cells such as the spermatocytes of crustaceans or molluscs, from which fig. 1, A-E, are drawn. In fig. 1, A, all the known parts found in the Golgi region are shown. The words "Golgi region" mean that part of the cell in which the Golgi apparatus and its associated structures lie when in the juxta-nuclear and excentric condition. In outline the elements in the Golgi region appear to be constituted by a number of spheres of different sizes in close contact. If the cell is examined *intra vitam*, and without staining or treatment of any kind, the appearance shown in fig. 1, B, will be noted. Outside the nuclear membrane on one side, the structure, marked g, can be seen. This body is always of characteristic shape and degree of hyalinity in various animals. It is visible in all spermatocytes the writer has examined, and is particularly clear in arthropods and mammals. If the cell is squeezed between two cover-slips, the Golgi apparatus can be moved about in the cell. If the cell be made to burst, the apparatus flows out, usually keeping its shape.

Now, if some 1 in 500,000 neutral red in Ringer solution be run under the cover-slip, within a varying period it will be noted that, in some types of cells, inside this hyaline outline, a number of densely red globules have stained up, as shown in fig. 1, D, at n r v. These globules stain pink to

* A bibliography is not given in this paper; the reader will find a list of publications in the Proc. Roy. Soc., B., 1929, vol. 104, p. 820.

cherry red, depending on a number of circumstances, of which time, strength of solution, and type of cell may be stated here. *In some animals staining is almost instantaneous*—that is, by the time the cover-slip has been placed on the preparation, and the cells focused, the red colouration has appeared. Moth spermatocytes are a good example of this.* Now, by careful focusing it will be evident that the neutral red globules do not occupy the whole of the outline of the Golgi apparatus. In a later communication better examples will be given, but it suffices here to remark that, as shown in figure 1, D, an outline can be seen around each globule.

Turning for a moment to preparations made carefully by the Da Fano or Cajal formalin silver nitrate methods, the appearance shown in fig. 1, C, is usually found. This structure approximates closely to the classic reticulum of the Pavia school, though in some cases, with very well fixed and toned cells, the argentophile parts are separate, and do not form a continuous network.

Now, if we use the Carnoy (alcohol, acetic, chloroform) iron hæmatoxylin method, we will find the cells as shown in fig. 1, E, with a centrosome (centriole) and centrosphere. This is the appearance also got by the current protozoological technique such as Dobell's alcoholic Bouin, and ælum hæmatoxylin. It is hardly necessary to say that such cells bear no close relationship to the same structures *intra vitam*.

Finally, if we prepare cells by the Kolatschew (chrome-osmic) method, we will get an outline similar in every way to what we discovered when examining the cells *intra vitam*, except that the outline of the globules is black, the neutral red part being colourless, or at best yellowish. Such a cell is shown in fig. 1, A. It is, however, rare in Kolatschew preparations to see the region of the globules so clear.

Now, the reader will wonder what parts should be called the Golgi apparatus. It will be evident that there is some truth in all the appearances, yet it is not difficult to come to a conclusion. The appearance shown in fig. 1, C, is the Golgi apparatus, because it is the part which is argentophile, and which shows by Golgi's techniques. In fig. 1, C, the argentophile crescents and rods are merely, at least in the case of the cells at present under discussion, the thick, probably lipoid, cortices of the neutral red globules depicted in fig. 1, D. These globules collapse, and do not impregnate with the original rough Golgi methods, and those cells show the classic Golgi net best which have most cortex to the globule, if, indeed, the latter be present in the Golgi region.

In endeavouring to examine the question of what is to be called the Golgi apparatus, examination of young neurones and spermatocytes side by side is useful. It will be found that a similar argentophile net exists in both, in the

* In moth spermatocytes these globules can be seen without staining (Abraxas). They are not precipitates from the neutral red stain, as has been supposed to be the case with some other supra-vital dyes.

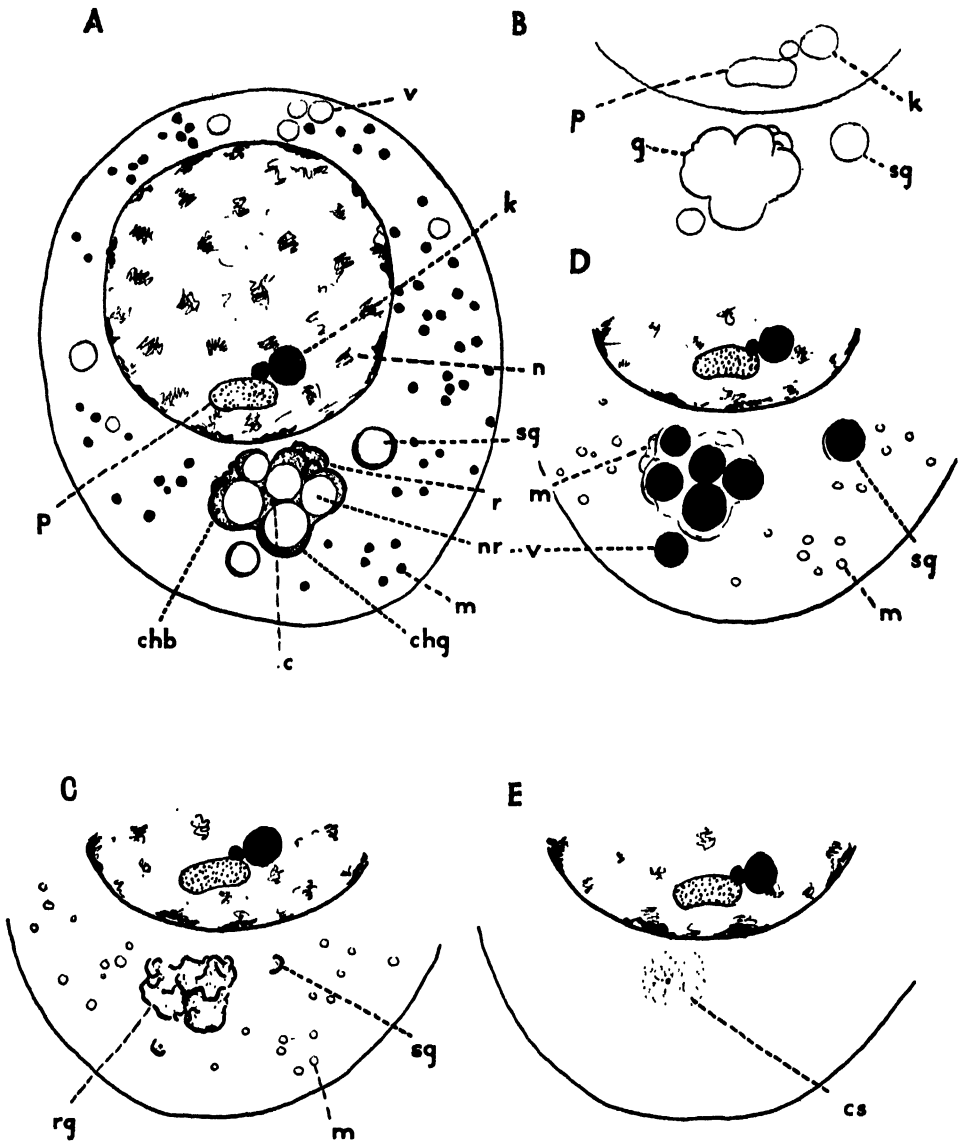


FIG. 1.

A.—Cell prepared by Champy-Kolatschew method.

B.—Seen *intra vitam*.

C.—By Da Fano cobalt formalin silver method.

D.—Stained supra-vitally with neutral red.

E.—Fixed in alcohol acetic and stained with hæmatoxylin.

Letters :—c, centriole ; c h b, centrosphere or archoplasm ; c h g, Golgi cortex of vacuome ; c s, centrosphere ; k, karyosome ; m, mitochondria ; n r v, neutral red staining vacuoles (vacuome) ; p, plasmosome ; r g, argentophile part or real Golgi apparatus ; r m, region where Golgi bodies are multiplying ; s g, Golgi element with contained vacuome drifting out into cytoplasm ; v, ordinary cell vacuole.

same position, quite apart from any question of a demonstration of neutral red globules. In practically all formalin or chrome silver preparations of the Golgi net, accompanying the argentophile crescent or rod will be found a denser part of protoplasm, sometimes known as the sphere substance. This is depicted in fig. 1, C, by dots, and is shown in both detached parts of the Golgi apparatus at b g. There can be no doubt that this substance is an integral part of the argentophile elements, especially in germ cells.

We know that Golgi elements can exist apart from the neutral red staining globules, but we are less certain whether this sphere substance is ever absent. The writer does not regard it as a necessarily definite part of the Golgi material, as its presence in certain vertebrate neurones and the protozoon contractile vacuole cortex is doubtful.

It is now possible to use the words "Golgi apparatus" for the argentophile or osmiophile region. This part definitely is brought out by the old and new osmic and silver Golgi methods. The old terms centrosphere, archoplasm, etc., are still useful to define the sphere substance apart from Golgi cortices, and the material in fig. 1, E, at c s, is regarded by the writer as an integral part of the Golgi apparatus of many types of cells.

When we come to consider the status of the neutral red globules, there is even less difficulty. These globules, in such cells as are under discussion, are spaces in the archoplasm filled with a substance which stains red in neutral red. It is not proposed for the moment to define the statement "stains red." The neutral red system of globules thus associated with the Golgi apparatus is probably always present in some form or other in the cell, and is regarded by the writer as a product of the Golgi apparatus and not as the Golgi apparatus itself. Its exact nomenclature is not a matter of great importance, but it does *not* constitute the material which goes black in the osmic or silver Golgi methods. This, in the writer's opinion, is enough to settle the question whether or not it should be called a Golgi apparatus.

The objections to including the neutral red globules under the term Golgi apparatus are as follows:—

(a) In certain cells the argentophile or osmiophile parts are separate from the neutral red globules, as has been shown by Voinov and Hirschler, and confirmed by the writer in a number of animals.

(b) The Pavia school did not describe the neutral red part as the Golgi apparatus, but used this term for the collapsed cortices of either globules or canals whose contents are not necessarily demonstrable by the silver impregnation methods.

(c) Some name must be given to the argentophile cortex as opposed to the neutral red globule even when the two are associated, and the invention of a new name such as "lepidosome" (Parat) does not tend to clarify the situation. A name for this part has existed for over thirty years—that is, *Golgi apparatus*. There can be no justification for altering this nomenclature.

(d) The "apparato reticolare interno" of Camillo Golgi is an argentophile net and not a series of neutral red globules. The substance of the globules

does not stain in silver. The neutral red globules, where separate from the silver impregnating cortices, do not give an argentophile net when treated with formalin or chrome silver Golgi apparatus methods (see below). It cannot be claimed, therefore, that the neutral red granules can exhibit the argentophile net recognised by the Italian school as a Golgi apparatus.

(e) There is strong evidence that the contractile vacuole of Protozoa is homologous with the vacuome or vacuoles of Metazoa. But the contractile vacuole disappears and reappears, which the Golgi apparatus does not do.

When we raise the question as to whether the neutral red globules should be considered as an integral part of the Golgi apparatus, we are on altogether different ground. There can be no doubt whatever that in animal cells the argentophile structure called the Golgi apparatus is practically constantly accompanied by neutral red globules, either inside the archoplasm or just outside the focus of the apparatus. Very definite information with regard to this part of the nomenclature can be got by studying the phylogeny of the Golgi apparatus along the lines so brilliantly developed by Dimitry Nassonov. Briefly, Nassonov has demonstrated that the cortex of the "excretory" apparatus or contractile vacuole of the Protozoa and the Golgi apparatus of the Metazoa are similarly osmiophile. The contractile vacuole, according to Nassonov, is a space almost always inside a lipoid membrane. It is the lipoid membrane which osmicates in the characteristic manner found in the metazoon Golgi apparatus, where the vacuole is often absent. According to the nomenclature used by the writer, the Golgi apparatus is the cortex, while the contractile vacuole, a space which appears and disappears at intervals, represents the vacuome. The cortex does not disappear at systole. Therefore even in its protean form the Golgi apparatus and the vacuole are distinct. Furthermore, as Nassonov brings out in his second paper on the subject, the contractile vacuole, as in the form Dogielella, may exist as a ring around and outside a vacuole (fig. 2, C).

The writer would have no objection to using the words "Golgi apparatus" to include the globules and vacuoles, contractile or otherwise, except for two facts :—

(a) The words "Golgi apparatus" were understood by Golgi to mean the argentophile part shown in fig. 1, C.

(b) The neutral red part may be outside the argentophile structure (fig. 2, A). How, in this case, are we to use the words "Golgi apparatus"? Must we alter the old nomenclature, which covers a multitude of previous investigations, or may we bring in a new name for the more recently recognised structure? The latter alternative is the preferable one, because it enables us to review the work of the older investigators, still using their nomenclature, and to signify the new structure in a way not leading to confusion. Thus the argentophile bodies can still be called Golgi apparatus, and the neutral red globules inside or outside can be called "vacuome" (Parat), vacuolar system, neutral red globules or vacuoles, etc., and everyone will understand what is meant.

The application of this form of nomenclature can best be illustrated by taking four types of cells other than that given in fig. 1. The example given in fig. 1 is probably commonest, and would apply to the vertebrate neurone, but other types, such as in fig. 2, A—D, are widespread, among animal cells at least. In fig. 2, A, is a *Saccocirrus* (archiannelid) spermatocyte in which there is a vacuolar system on the left of the Golgi apparatus. This type exists in mammals such as *Cavia cobaya*. Now, in such cells there can be no doubt that the vacuoles are not the argentophile or Golgi part. Golgi, Cajal and Da Fano formalin silver methods blacken the Golgi part, and the net is found in that region only. The suggested system of nomenclature in which the net-region is called *Golgi apparatus*, and the neutral red vacuoles *vacuolar system*, is therefore clear.

Turning to another type, the insect spermatocyte or spermatid shown in fig. 2, B, we find the argentophile or osmiophile bodies are dispersed, appearing as blackened cups, crescents, or rodlets. The vacuolar system is present as in the cell in fig. 1, A. The dispersed argentophile or osmiophile structures are called the *Golgi bodies*, the neutral red vacuoles the *vacuolar system*. Again this nomenclature is clear.

Now, according to the Parat nomenclature, in cell fig. 2, A, the argentophile structure is formed of "lepidosomes" (modified mitochondria), whereas the Golgi apparatus is the group of neutral red granules. But Golgi, Cajal and Da Fano, Golgi apparatus methods, impregnate the "lepidosomes" and not the "vacuome" (vacuolar system). When we turn to cell fig. 2, B, we find the same difficulty. No "net" exists in such cells at this stage, and the vacuolar system does not impregnate up as an "apparato reticolare." The bodies which impregnate either with osmium or silver are the dispersed structures called "lepidosomes" by Parat.

In fig. 2, C, is a protozoon (*Dogielella sphaerii*), after Nassanov, showing two vacuoles (contractile), each associated with a Golgi *ring* in black. In this example the osmiophile material does not form a cortex to the vacuole, and at systole the vacuole collapses, shrinking away from the ring. In fig. 2, D, of *Zoothamnium arbuscula* the contractile vacuole, v, is surrounded by the Golgi cortex completely.

Here again we cannot use the Parat nomenclature. The vacuole (vacuome) is undoubtedly not an argentophile or osmiophile impregnating space, but the cortex is demonstrated by the Nassanov method used to show the Golgi apparatus of Metazoa. The Golgi apparatus of Metazoa cannot be compared with a vacuole which appears and disappears as does the contractile vacuole, but homology between the osmiophile cortex and the argentophile or osmiophile metazoon Golgi apparatus is possible. According to Parat, the cortex of the Golgi apparatus is formed of modified mitochondria (lepidosomes). We reject both the idea that Golgi bodies are modified mitochondria, and that the vacuolar system is argentophile, and ever forms a blackened network in the animal cell. There is not the remotest resemblance between the osmiophile cortex and the mitochondria of any cells known to

the writer. In addition, perfectly normal mitochondria exist in Protozoa, and never show any such definite relationship to the contractile vacuole.

In a recent publication Maurice Parat suggests the use of the term "Golgi region." Presumably this is a step from his original position to one nearer

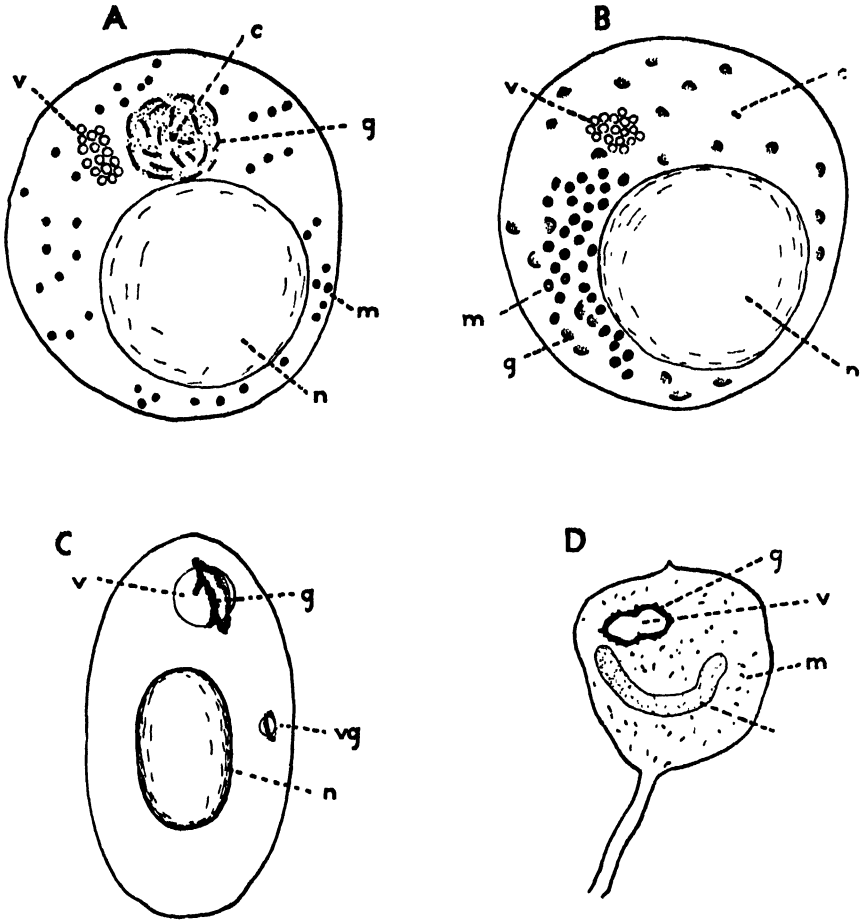


FIG. 2.

A.—Annelid (*Saccocirrus*) spermatocyte.

B.—Moth spermatocyte.

C.—Protozoan, *Dogielella*.

D.—Protozoan, *Zoothamnium*.

Letters:—c, centriole; g, Golgi apparatus; v, vacuole, or vacuolar system (vacuome); n, nucleus; m, mitochondria (not shown in *Dogielella*).

that held by most other observers. The words are useful, and are used by the writer, but the difficulty here is that the nomenclature does not define enough. The "Golgi region," according to Parat, would contain not only argentophile structures, but neutral red bodies. These are not the same thing. Parat calls the argentophile parts the "lepidosomes," and the red globules

"vacuome." The latter word has been accepted by the writer, and there can be no objection to its use. When the word "lepidosome" is used, it should be understood that it is the same part as goes black under formalin silver treatment, and as is called Golgi apparatus by Golgi and his pupils.

The thesis put forward by Parat that the "lepidosomes" are modified mitochondria has not been accepted to any degree by other workers. It is a matter of common knowledge that in most animal cells properly prepared by the Golgi formalin silver methods, the mitochondria either do not stain at all or become yellowish. Over-impregnations may cause a black colouration of these bodies, but subsequent toning usually extracts them, leaving the true Golgi apparatus black.

During the sixteen years the writer has used the osmic and silver Golgi methods, he has never met with a case in which there was real difficulty in discriminating between the Golgi bodies and mitochondria. The best-known instance of such difficulty is in the neurones of such animals as the snail. Kolatschew, using the osmic method now known by his name, claimed that there *might be* (sic) intermediate forms between Golgi elements and mitochondria. In this laboratory A. M. Gwynn and the writer have examined a number of Kolatschew Da Fano chrome-osmium and supravitaly stained preparations of such neurones. We had a little difficulty in discriminating between the two categories of granules, but consider that the discrimination is possible. Curiously enough, however, it is in the pulmonate molluscs that the Golgi bodies have been traced from oogonium to segmented egg, and from segmented egg to embryo, so that the evidence brought forward by a study of adult neurones is hardly likely to convince anyone who has examined a series of eggs and embryos where the Golgi bodies and mitochondria are absolutely different in staining and morphology, through various stages of organogeny.

The test of a cytological nomenclature is how it works when applied, not to one category of cells, but to the whole of cytology, and the terms given here are claimed by the writer to be universally useful, and to conform to both the findings of the older and the newer generations of cytologists, and to both Protoza and Metazoa. With this nomenclature it becomes possible, in an account of the Golgi apparatus, to consider the work of the Pavia school on its merits. The Italian workers, as shown in fig. 1, A-E, really described something that was present *intra vitam*, only they did not recognise the vacuolar system. No modern work has negated any part of their results. At the most, modern investigators have shown that in some, but not all, cases the silver or osmic impregnating substance existed in a slightly different form.

Fig. 1, A-E, gives the writer's views on modern nomenclature. All cells, both animal and plant, germinal and somatic, would seem to be equipped as is the example in fig. 1, A. The vacuolar system may be inside the argentophile or osmiophile substance, or outside it, the Golgi apparatus may be concentrated as in this example, or spread out as variously shaped elements

in the cytoplasm, these elements may or may not be attached to neutral red globules or contractile or non-contractile vacuoles, but, in the end, all the various types may be brought into relationship with the example given in fig. 1, A.

It is not proposed for the moment to enter deeply into the question of the nomenclature of plant cells, but it can be shown that the adopted system works well in the case of plant cells already known. We owe this to the labours of Robert Bowen, who demonstrated osmiophilic discs in plant cells which closely resemble the Golgi bodies especially of certain insect germ cells. The subject will be treated more fully later, but it may be said here that a neutral red staining vacuolar system cannot be regularly demonstrated by treating plant cells in neutral red solution, nor do the formalin silver nitrate Golgi methods act satisfactorily with plant tissues. The writer believes that plant cells have a dispersed Golgi system (as in fig. 2, B), mitochondria, and plastids which are probably derived from mitochondria, and that a vacuolar system of the type found in animals has not been demonstrated. One does find intra-cellular spaces the contents of which may impregnate with various substances, but the allegation that these spaces are anything except intra-cellular watery vacuoles has yet to be proven. Apart, however, from the question of the homology of intra-cellular watery spaces in plants and the undoubtedly lipid vacuolar system in higher animals, there can be no doubt that the mitochondria of plants and animals are one and the same thing. The homology of Bowen's osmiophilic platelets with the Golgi bodies of animals will be denied by the supporters of the "vacuome" hypothesis because it is most damaging evidence against the "vacuome" hypothesis. This homology, together with the evidence provided by such cells as those in fig. 2, A, B, and C, where the argentophile Golgi apparatus and the "vacuome" are separate, in the mind of the writer makes belief in the "vacuome" hypothesis contra-indicated.

The writer, however, can see no objection to the homologising of the intra-cellular vacuoles of plants with the vacuolar system in animals. It may be that, as with the formalin silver methods in plants, the neutral red method, so successful in animal cells, is unsuccessful when applied to plants. It would be unwise to deny homology on the grounds of failure of such a test as neutral red staining. Admitting such a homology, the plant cells we know would correspond to the animal cell given in fig. 2, B.

GLOSSARY OF TERMS.

1. *Golgi Apparatus Region*.—In probably all embryonic metazoan cells the Golgi apparatus occupies a definite region beside the nucleus and in the centre of that part of the cytoplasm not occupied by the nucleus. This may be called the Golgi apparatus region.

2. *Golgi Apparatus*.—In the Golgi apparatus region of embryonic cells, and usually dispersed in older cells, there exists an argentophile or osmiophile substance, arranged as cups, rods, nets, cortices to vesicles, granules, crescents, etc., usually in a characteristic manner in each sort of cell. This material constitutes the Golgi apparatus.

3. *Golgi Body, Golgi Element, Golgi Crescent, Golgi Cup, Golgi Granule.*—These terms refer to the separate parts of the Golgi apparatus when not associated with part or parts of the vacuolar system (see next).

4. *Vacuolar System, Vacuome, Vesicles or Globules of the Vacuolar System, Parat's Apparatus or System.*—An aggregation of neutral red staining granules or vacuoles, very characteristic in appearance in germ cells at least, usually, if not always, associated with the Golgi apparatus during some part of the life of the metazoon cell. Sometimes the globules are inside the Golgi cortex, sometimes outside in a close group. In embryonic and germ cells the vacuoles stain bright red in pink Ringer's solution, and blue in Nile blue sulphate. These vacuoles very probably are the homologues of the contractile vacuoles of Protozoa.

It is not known whether all neutral red globules in cells belong to this system.

5. *Golgi-Vacuole, Golgi-Vacuome, Golgi-Vesicle.*—Often in egg and gland cells especially Golgi bodies and vacuoles of the vacuolar system are associated, the former as an osmiophile or argentophile cortex of the latter. The two together form a Golgi-vacuole.

6. *Archoplasm, Sphere.*—In many germ cells the Golgi body has a (chromophobe) region attached to it, which usually stains golden in formalin silver, grey or not at all in hæmatoxylin, etc. When aggregated these parts form a sphere, in which the vacuolar system may be embedded. The sphere is left after Carnoy, corrosive acetic, fixation.

IV.—THE PROJECTOGRAPH.

AN OPTICAL INSTRUMENT FOR THE PROJECTION OF IMAGES
OF MICROSCOPICAL OBJECTS.

By T. E. WALLIS, B.Sc., F.I.C.,

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Pharmaceutical Society of Great Britain.*(Read November 20, 1929.)*

ONE PLATE.

IN the course of certain pharmacognostical work it is necessary to be able quickly and accurately to compare certain plant structures, to make counts of particles, and to construct careful drawings. To carry out such work by means of the ordinary camera lucida or by eyepiece scales is a very tedious process. Much greater ease of working and, consequently, an increased confidence in the accuracy of the observations is obtained by projecting the microscopical images on to a table where they can be observed with comfort, and studied or counted without the necessity of making drawings. The instrument described in the present communication was designed for carrying out such work, and has proved very satisfactory during the twelve months that it has been constantly in use. The same apparatus has also given every satisfaction for use in illustrating minute structures by the projection of microscopical slides upon a screen in the lecture room. For making drawings it is both more accurate and more convenient in use than any form of camera lucida.

The construction of the instrument is described below, and reference to the figures will explain those details which are difficult to describe in words. The source of illumination is a 250-watt concentrated filament lamp, mounted upon a stand with a concave mirror, M^1 , in the same way as for an ordinary projection lantern ; both lamp and mirror are adjustable in both the vertical and horizontal planes. The lamp-tray, T, is made to slide in runners upon a base-board, B, and is covered by a sheet-iron casing open at the back, where a small curtain is arranged to keep light from the room, and having a cowl immediately over the lamp itself. The other half of the base-board

carries a box-like structure, in the front end of which is fitted a condensing lens, C, of about 8 inches focal length ; the hinder end is left open. In the top of the box is a hole, H, arranged to allow a beam of light to be projected vertically upwards from a plane mirror, M², adjusted at an angle of 45° to the horizontal, and arranged so as to slide to and fro in the interior of the box for purposes of adjustment. Screwed to the top of the box is an ordinary dissecting microscope stand provided with a focusing substage and a specially constructed arm to carry objectives and other apparatus. This arm is pierced by a hole at the free end. This hole is lined by a tube carrying a screw-thread to take ordinary microscope objectives, or a revolving objective changer (nosepiece), and is extended above with a screw-thread on the outer surface having the same gauge and pitch as that of an objective, so that a clamping ring, R, may be screwed down on to it, or other standard apparatus (such as a polariscope analyser or Davis shutter) may be attached to the upper side of the arm. The image formed by the objective is projected horizontally by a right-angled prism mounted so as to be movable about a horizontal axis in a small frame which is fixed in position by the clamping device referred to above, and can be rotated about a vertical axis by releasing the ring. Beneath the frame of the right-angled prism is attached a blackened disc of sheet iron, S, 4 inches in diameter, so as to cut off stray light.

If it is desired to exhibit the objects to an audience, the horizontally projected image is received upon a conveniently placed vertical screen. The movable right-angled prism enables the image to be projected in any desired direction without moving the instrument or disturbing any of the adjustments. For drawing or inspection upon the bench, the horizontal beam leaving the prism is received upon a plane mirror, M³, set at an angle of 45° to the horizontal. This mirror deflects the beam on to the table upon which the instrument stands, and the image can be readily traced upon a sheet of paper or used for inspection by the eye. The mirror is mounted upon a frame which is clamped to the side of the box containing the microscope, and can be instantly removed with its frame by turning a single wing-nut. The lower part of this frame carries a strip of blackened sheet iron, B, 8 inches wide, to screen reflected light. The mirror itself is attached to the frame so that it may be easily rotated about a horizontal axis. This mirror, M³, should be silvered upon the surface if the image upon the table is to be a really critical one, but for all ordinary purposes, with objectives of moderate power, the doubling produced by a piece of thin carefully selected ordinary mirror is negligible, and the image is quite satisfactory. The substage of the microscope is provided with an ordinary Abbe condenser. The wood used in the construction of the instrument is teak, and the piece of wood holding the large condensing lens, C, is faced on the side towards the lamp by a sheet of stout asbestos cardboard, A.

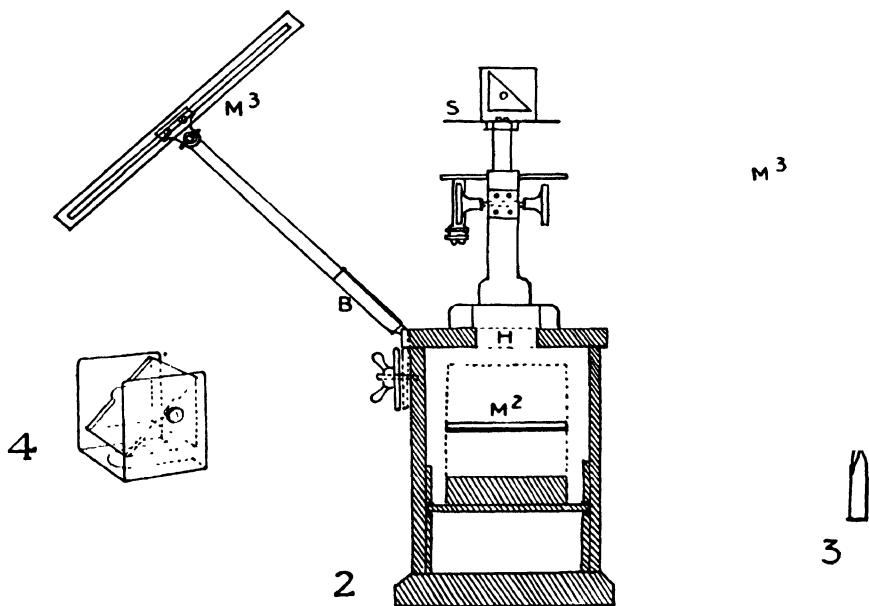
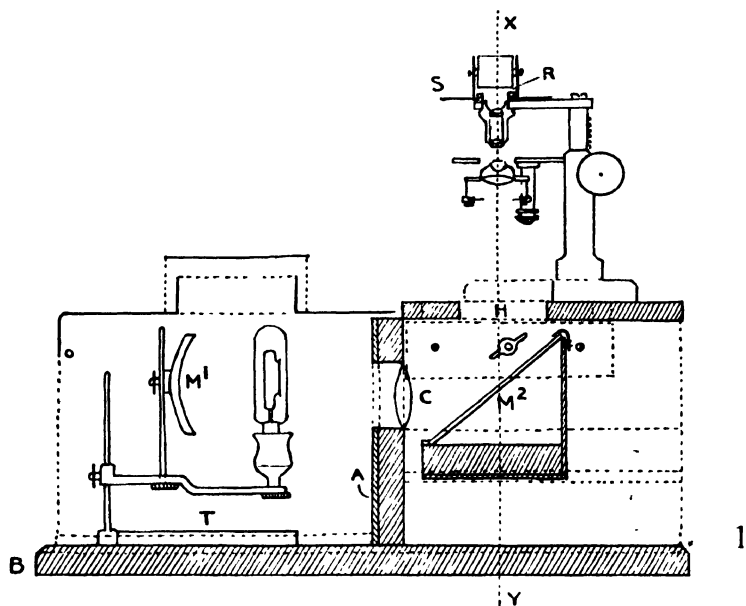
To set up the instrument the following procedure is recommended : arrange the filament of the lamp as nearly as possible opposite to the centre of the lens, C, and parallel to the plane of the lens. Remove the top lens

from the Abbe condenser, rack it down and turn it aside. Place a piece of thin card or stiff paper in the normal position of the lens of the substage condenser, and, by sliding the lamp-tray, focus an image of the filament upon the card. Next adjust the concave mirror, M^1 , behind the lamp until the image it produces upon the card coincides with the image of the filament itself. Now place a microscope slide upon the stage and focus the image with a low-power objective (about $1\frac{1}{2}$ inch) upon the table or upon a vertical screen, next remove the microscope slide from the stage, swing the substage back into position, and focus up until a sharp image of the condensing lens, C , is seen upon the screen. Under these conditions the field upon the screen should be circular in outline and should be very evenly illuminated. On now placing a microscope slide upon the stage, a well-defined image will be visible upon the screen or table.

For low-power objectives, up to $\frac{3}{8}$ inch, the top lens of the Abbe combination should be removed; for higher powers, from $\frac{1}{2}$ inch upwards, the top lens should be left in position, and the iris diaphragm slightly closed until the peripheral glare is cut off. When using the higher-powered objectives, the image is improved by attaching, immediately above the objective, a Davis shutter, above which the prism is then fastened by means of the clamping ring. A slight closing of the diaphragm of the Davis shutter will now improve the definition of the image.

The special features embodied in the apparatus are :—

1. The microscope slide is placed upon a horizontal stage, and consequently the mounts may be either temporary or permanent in character.
2. The lamp is a concentrated filament lamp of 250 volts, and can be used on any ordinary lighting circuit at a pressure of 100 volts. For other voltages a small resistance is needed.
3. The heating of the slides is very much less than that produced by an arc lamp, and is, for all ordinary purposes, negligible in amount.
4. The image of the slide can be projected in any direction by rotating or tilting the prism.
5. Much loss of light is avoided by fixing the prism immediately over the objective.
6. Ordinary microscope objectives are used, and can be changed by using an ordinary objective changer (revolving nosepiece).
7. The instrument gives excellent results by dark-ground illumination and with the polariscope.
8. With the exception of the box and the special arm carrying the objectives and other apparatus, the whole of the parts used are standard fittings as ordinarily sold by microscope and projection lantern makers, so that the instrument can be readily constructed from materials in stock by any firm of optical instrument makers.
9. The whole instrument is compact and sufficiently portable to be easily carried by hand.



The drawings and particulars for the construction of the "Projectograph" have been handed to Messrs. W. Watson and Sons, of 313, High Holborn, London, W.C. 1.

DESCRIPTION OF THE PLATE.

1. Median longitudinal section of the "Projectograph."
 2. Section at right-angles to 1, along the line xy.
 3. Details of the mirror and frame attached to the side of the box for drawing or projection on to a table.
 4. Enlarged drawing of the prism and its support.
- N.B.—Fig. 4 is drawn to twice the scale of the other drawings. Explanation of the lettering will be found in the text of the paper.

V.—A MICROSCOPE LAMP.

By F. WELCH, F.R.M.S.

(Read December 18, 1929.)

ONE PLATE AND TWO TEXT-FIGURES.

So many lamps have been designed for use with the microscope that the production of a novelty would appear to be difficult. The one to be described is not entirely original; it has been evolved as the result of laboratory experience, and is an attempt to overcome some of the disadvantages to be found in many existing types of electric microscope lamps. Most of those at present in use which are sold at a moderate price consist of a cylindrical container—often an empty tobacco tin—in which is placed an electric lamp. A hole is made in the front of the tin, through which the light passes to the microscope, and an ordinary lamp-holder is inserted in another hole at the top. The electric bulb used is commonly opal or ground glass, and this lamp does, in fact, answer most ordinary purposes. Its disadvantages are that it is not heavy enough to ensure freedom from movement, any interference with the flexible electric lead will displace it, and it quickly becomes too hot to handle. Further, as illuminants opal and ground-glass globes are not ideal from a microscopical standpoint; the light emitted is increased in mean wave-length on passing through most opal glasses, and even initial efficiency is not maintained for any great length of time. The lamp now used in the laboratory in which I work is similar in principle to one described before this Society by Mr. J. W. Gordon so long ago as June 17th, 1908. The method is to use a glass rod, which Mr. Gordon called a speculum, to transmit the light from the illuminant to the microscope mirror. A similar appliance was used long before this; I think that Zeiss made a bent glass rod for this purpose many years ago, although I am unable to find a description in any literature at my disposal. This method was a satisfactory one when Nernst filaments were available; it was, in fact, probably the best electrical illuminant that had hitherto been made, but it did not prove so satisfactory with any ordinary filament lamp. Mr. Gordon (1908), in his paper on "Illuminating Apparatus for the Microscope," draws attention to the optical advantages to be expected from the use of a speculum, so that there is no need for me to go over the ground again in detail. In practice the chief advantages are that the illuminant is of uniform intensity and is circular in shape. Its effective size can easily be varied if desired, and,

most important of all, its intensity can be altered within wide limits without any change in quality. It is doubtful if this type of illuminant would have been brought into use again had it not been for the invention of the half-watt gas-filled lamp, with its high intensity, and with a spiral filament short in

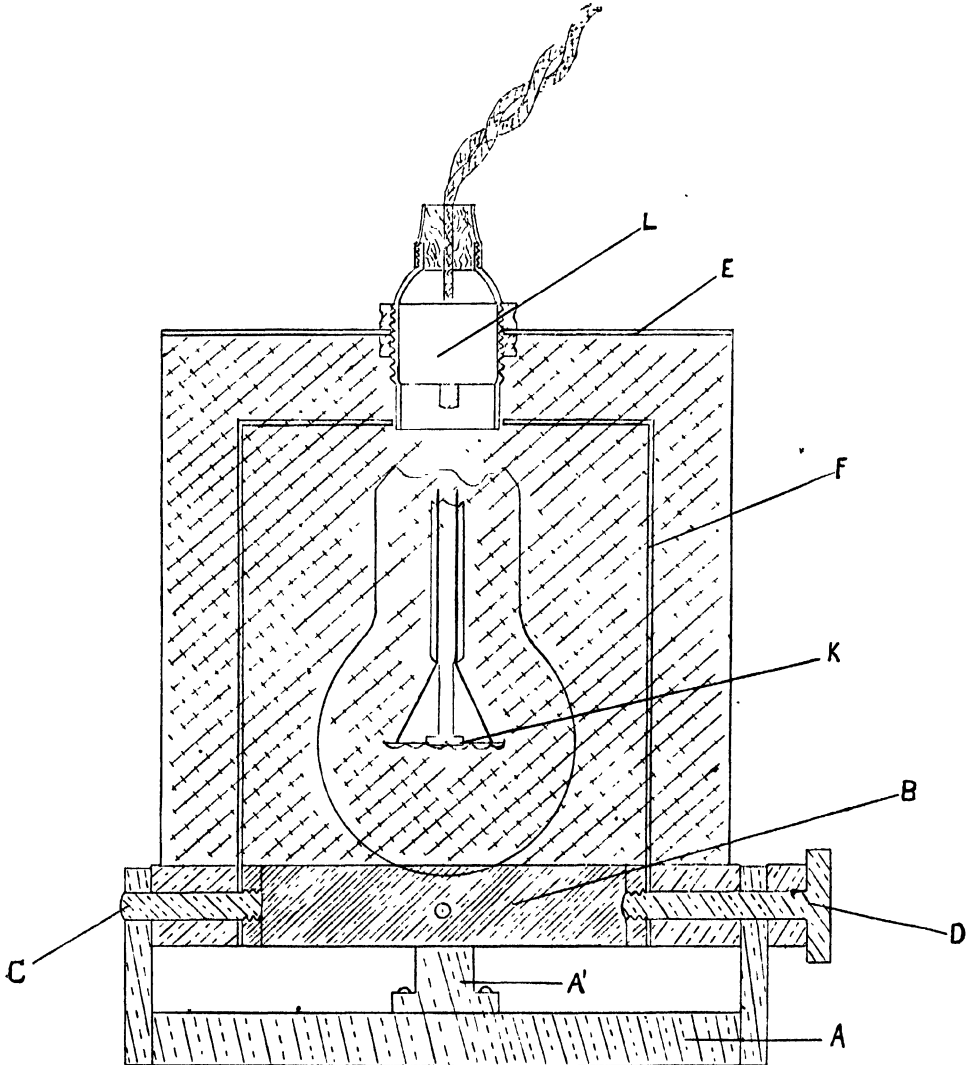


FIG. 3.

effective length. The effect of this is that a considerable quantity of light can be collected by the speculum, so much, in fact, that even with high powers the intensity is uncomfortably great. The coiled filament is shown in fig 1, magnified by 20 diameters, and from this it will be realised that a considerable portion of the total light emitted can be collected by a glass

rod with a diameter of about $\frac{1}{2}$ inch. The design of the casing of the lamp, which is its chief characteristic, will be seen in figs. 2, 3, and 4. The base consists of a square cast-iron frame, A, which supports another similar frame, B, of smaller size. The latter is supported in the former by means of

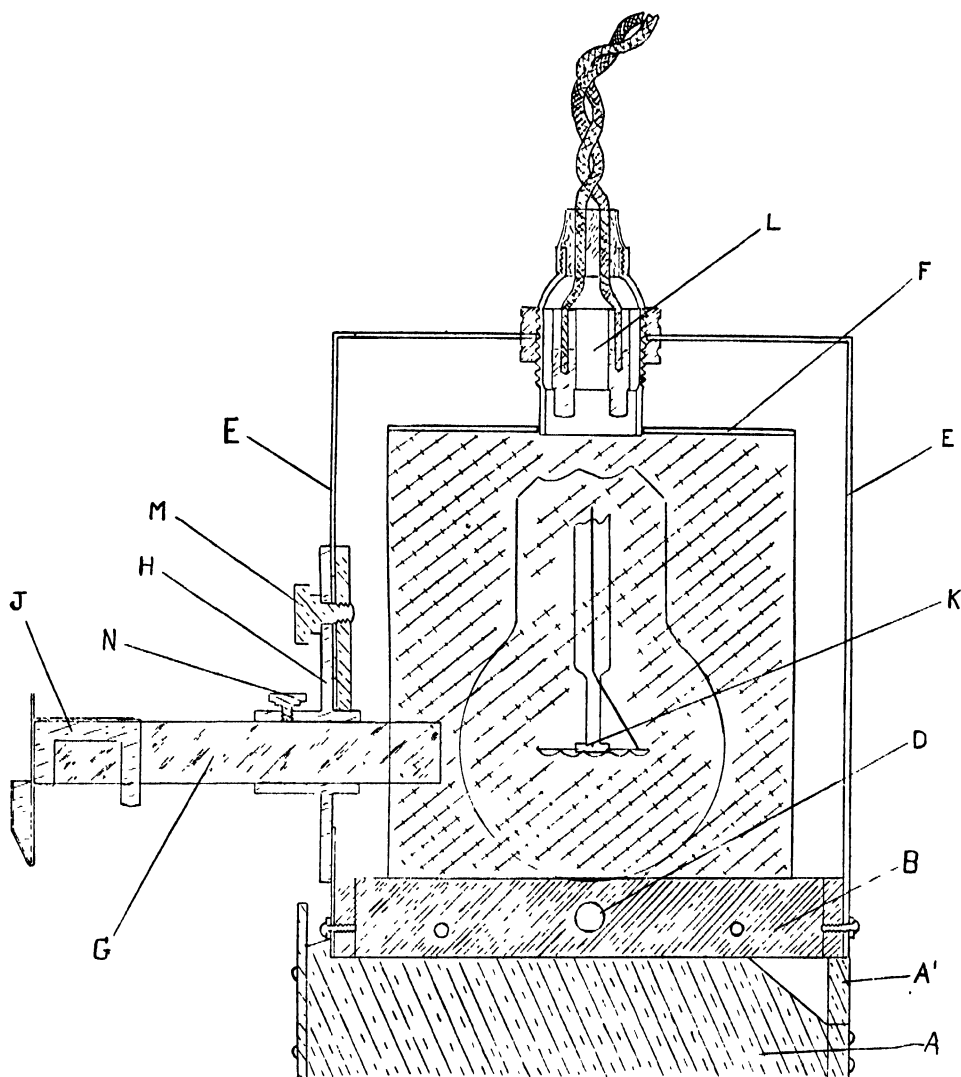


FIG. 4.

a pivot, C, and clamping screw, D, on opposite sides of the rectangular base, so that the frame B can, within limits, be inclined to any desired angle in relation to the microscope. The light-excluding device consists of two strips of thin metal, such as sheet aluminium, E and F. Each of these strips is supported on the iron frame B on opposite sides,



Fig. 1.

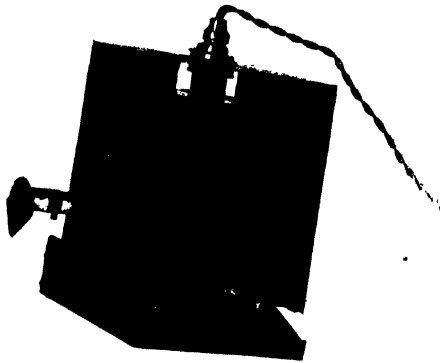


Fig. 2.

so that there is a space between them, and so that they are not in contact at any place. The drawing shows this effectively. The lamp is supported in the outer casing, but passes through a hole in the inner casing. The result is that little heat is conducted to the outer casing; it is not too hot to handle even after several hours' constant use. The glass rod G is supported in an adjustable holder, H, which allows movement vertically, and is provided to ensure that the filament of the lamp is exactly opposite to the centre of the glass rod. Such an adjustment is essential when a new lamp is taken into use; the filament is not always in the same position in the bulb. The plate H, therefore, is free to move up or down on the lamp casing, and can be clamped into position by the screw M. The glass rod G is held in a tubular fitting, in which it is free to move to or from the lamp. A small fitting, J, is shown on the microscope end of the glass rod which will hold a colour screen or neutral glass modifier. The glass rod should be as free from defects as practicable, and should be lightly ground at the end near to the lamp and polished at the other end. To set up the lamp and to ensure that the rod is opposite the filament, a pin-hole camera is provided. This is a piece of brass tube, of the same size as the glass rod, which can be put in place of the latter. One end of the tube is closed except for a central pin-hole, and the other end is open to allow a small piece of ground glass to be placed over the opening. Thus an image of the lamp filament is thrown on to the ground glass, and the glass-rod holder is adjusted until the image is central. The only other adjustment necessary is to move the glass rod either nearer to or further from the bulb until any desired intensity is obtained, and this adjustment can easily be made to suit any conditions that arise. It is advisable to have the lamp near to the mirror and so tilted that the end of the glass rod is exactly opposite to its centre. Under the widely varying conditions that arise in a large research institute, this simple appliance has proved to be entirely satisfactory.

REFERENCE.

GORDON, J. W. (1908).—*J. Roy. Micr. Soc.*, **28**, 425-9.

VI.—SOME NEW FORAMINIFERA FROM THE SOUTH ATLANTIC.

III.

Miliammina, a New Siliceous Genus.

By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.

(Read February 19, 1930.)

ONE PLATE.

APART from certain fossils of which we have little personal experience, the existence of really siliceous Foraminifera has always appeared to be a matter of uncertainty. A statement by Brady (1) is probably responsible for the opinion expressed by Lister (2) and Cushman (3) that tests of nearly pure silica may be developed under deep-sea conditions of life. Writing of the organisms found at Challenger Station 238, in the North Pacific, at a depth of 3,950 fathoms, Brady says: "*Miliolae* were the only representatives of the calcareous forms, and the shells of these were no longer calcareous, but consisted of a thin film of homogeneous silica, unaffected by acids, and iridescent when first taken out of spirit." . . . "A few *Miliolae* . . . were found to be unaffected by acids, and, upon further examination, it became apparent that the normal calcareous shell had given place to a delicate homogeneous siliceous investment." It would appear from this that Brady had actually dealt with these specimens; but Heron-Allen (4) states, on the authority of Sir John Murray, that the specimens observed on board the "Challenger" were not preserved, and that Brady's statement was made on the strength of Murray's notes, and not from the examination of actual specimens.

It is almost certain that the objects seen by Murray were chitinous linings such as are common to all Foraminifera. At any rate, so far as we are aware, no one has subsequently described recent siliceous Foraminifera, although chitinous specimens have been observed in both deep and shallow waters by many persons, ourselves included. The discovery of truly siliceous Foraminifera in recent dredgings is therefore a matter of more than ordinary interest.

In the first place let us define the term "siliceous" as meaning "capable of resisting the action of strong acids without structural change." There

are many Foraminifera belonging to various groups which, on superficial examination, might be considered siliceous, but which will not withstand this test. All the Astrorhizidæ and Lituolidæ make more or less use of siliceous particles in the construction of their agglutinate tests, encrusting the chitinous membrane which forms their basic structure with sand grains embedded in a cement secreted by the animal, which contains varying proportions of silica, ferric oxide, and carbonate of lime. Moreover, many species of Miliolidæ are in the habit of encrusting their normally calcareous tests with sand grains of varying sizes, often in such abundance as to conceal the calcareous structure. But the apparently siliceous tests of the Miliolidæ are instantly dissolved with effervescence on the application of acid, while the ferruginous cement of the agglutinate forms, almost without exception, breaks down under the prolonged action of the same test. It is true that Brady (1), p. 286, states that "in rare instances silica or some siliceous compound is employed, either by itself or in conjunction with other mineral substances," but the only example he gives is *Reophax nodulosa*, of which he says: "The incorporating medium is more or less siliceous, sometimes to such a degree that large specimens, half an inch or an inch in length, preserve their form after all the calcareous and ferruginous constituents have been removed by means of strong acids, and still retain sufficient firmness to bear handling without injury." This exception can hardly be said to affect the general rule that acid destroys agglutinate Foraminifera.

The history of the organisms which we are now describing begins in 1913, when Fauré-Fremiet (6) figured and described an organism from the Antarctic which he assigned to *Miliolina alveoliniformis* Brady, a well-known coral reef species. Apart from the fact that Fauré-Fremiet's specimens had agglutinate tests and a cribrate aperture, it is clear that they had little in common with Brady's species. Fauré-Fremiet seems to have had doubts as to his identification, and raises the question as to whether his organism is not a true arenaceous form, isomorphous with Brady's species.

In 1914, Chapman (7) described and figured under the name *Miliolina oblonga* (Montagu) var. nov. *arenacea* some specimens from the Ross Sea in the Antarctic. He described his organism as "quite a constant form," differing only from the porcellaneous type of Montagu in the finely arenaceous material of the test. He also remarked that no porcellaneous specimens were found in the same dredgings, and that his organism is readily distinguishable from *Miliolina agglutinans* (d'Orbigny), which is an agglutinate species.

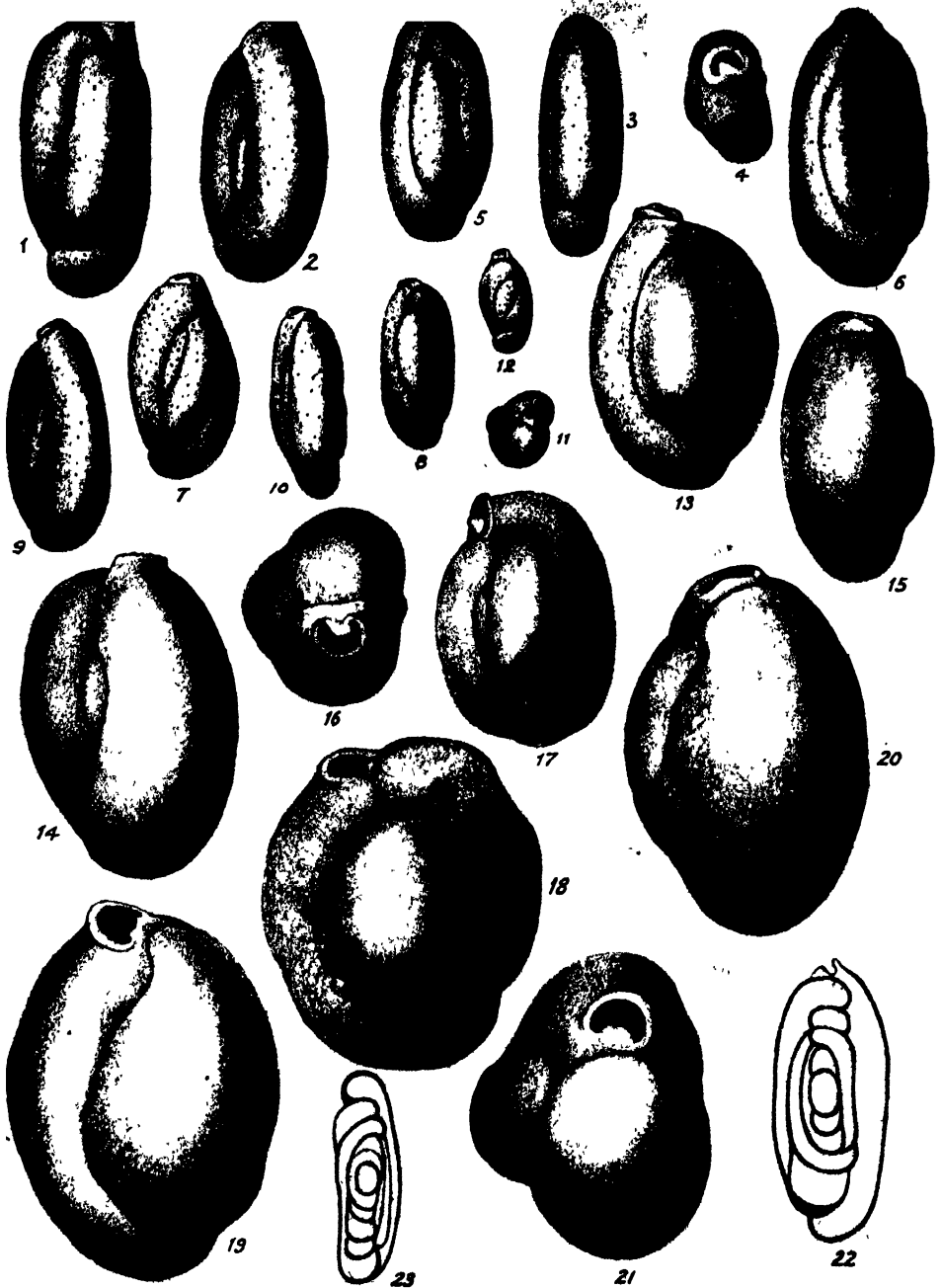
In 1922 we published a report on the Foraminifera of the "Terra Nova" Antarctic Expedition (8), in which we recorded that *Miliolina oblonga* var. *arenacea* Chapman (synonym *Miliolina alveoliniformis* Fauré-Fremiet non Brady) was the most typical Miliolid of the "Terra Nova" Antarctic collections, and that it presented a considerable range of form. Although a minute examination of the test was made to ascertain its constituents, no doubts were entertained as to its milioline nature, and consequently no

chemical tests were employed. Nor did we attempt to separate the different variations which were all listed under Chapman's name.

In connection with the examination of the "Discovery" material, it soon became apparent that Chapman's organism was a typical constituent of the muds in the South Georgia area, where it was found in nearly every sounding from moderate depths, and in great variety. In the course of experiments to determine the proportion of calcareous matter in the test (the South Georgia muds being almost entirely mineral and diatomaceous), we found to our surprise that there was none. Immersions in strong nitric acid under the microscope produced no effervescence, nor did 24 hours' immersion in acid affect the constitution or solidity of the test. It therefore became evident that we were not dealing with a *Miliolina* at all, but with an entirely new organism, for which we propose the generic name *Miliammina* (= sandy or siliceous "Milioliform" isomorph).

Miliammina is evidently closely related to a fossil organism recently described by Cushman and Church (5), from the Upper Cretaceous of California, under the generic name *Silicosigmoilina*. The wall is described as finely arenaceous, with siliceous cement on which the strongest acid makes no impression. The chambers are on a sigmoiline plan, and it is apparently isomorphous with *Sigmoilina* in the porcellaneous group except for its simple aperture, which lacks the tooth found in the calcareous genus. It is referred to the Silicinidæ, a family established by Cushman (3) in 1928 for the reception of the fossil genera *Silicina* Bornemann 1874, *Rzehakina* Cushman 1927, *Involutina* Terquem 1862, and *Problematica* Bornemann 1874. In the definition of the family it is stated that the wall is arenaceous, "usually siliceous, sometimes partly calcareous." Of the four genera, *Rzehakina* seems to have little in common with the others, but its structural plan is certainly near that of *Silicosigmoilina*, and its wall is siliceous. To what extent the other genera would withstand the acid test we cannot say, but *Involutina* at least has always been regarded as largely calcareous, and is included by Brady in his sub-family Endothyridæ.

Miliammina is evidently one of the Lituolidæ in Brady's system of classification, but is not easily placed in that family. The sub-family Trochammininæ includes many genera which have little obvious relationship to each other, though all characterised by neatly agglutinate tests. Many of them are isomorphous with other genera of porcellaneous and hyaline Foraminifera. In this connection it is noteworthy that no true isomorph of that large and important porcellaneous sub-family the Miliolininæ has been known until recently. *Miliammina*, *Silicosigmoilina*, and *Rzehakina* will now to some extent fill this gap, and as they agree in the siliceous constitution of their cement as contrasted with the highly ferruginous cement characteristic of the Trochammininæ, we propose to establish a new sub-family of the Lituolidæ "Silicininæ" for the reception of these three genera. The Silicininæ may be defined as having thin agglutinate tests consisting of numerous chambers, non-labyrinthic, arranged on a milioline plan, and



furnished with a terminal aperture, with or without a tooth, the wall composed of minute minerals and diatoms embedded in an excess of siliceous cement, with smooth or polished exterior and smooth interior surfaces.

Order—Foraminifera.

Family—Lituolidæ.

Sub-Family—Silicininæ.

MILIAMMINA gen. nov.

Test free, chambers arranged on a triloculine or quinqueloculine plan; wall imperforate, composed of very minute mineral fragments embedded in an excess of siliceous cement, smooth or polished, rarely rough. Aperture terminal, furnished with a tooth, perhaps sometimes cribrate.

MILIAMMINA OBLONGA (Chapman).

Plate, figs. 1-6, 22, 23.

Miliolina oblonga (Montagu) var. nov. *arenacea* Chapinan 1914 (7), p. 59, pl. i, fig. 7.

Miliolina oblonga (Montagu) var. nov. *arenacea* (*pars*) Heron-Allen & Earland 1922 (8), p. 66.

Test regularly quinqueloculine; chambers tubular, larger at the aboral extremity; peripheral edge rounded to sub-acute; sutural lines almost flush in the young stage, becoming more or less depressed with increasing size of shell. Aperture crescentiform at extremity of final chamber, sometimes on a somewhat produced neck, with or without a reverted collar, furnished with a small simple tooth. Wall thin, composed of minute mineral grains embedded in an excess of siliceous cement, smooth, often polished, in which case the mineral particles of which it is partly composed are more distinct. Colour variable from very light to dark grey, rarely brown, or affected by the colour of the mineral particles employed. Size very variable in different localities. Young individuals have been seen only 0.125 mm. in length, but average well-developed tests are about 0.40-0.50 mm. in length, 0.20 mm. in breadth, 0.15 mm. in thickness. The thickness of the wall in an adult shell is estimated at 0.005-0.010 mm., and the largest mineral flakes employed by the South Georgia specimens rarely exceed these dimensions. Elsewhere larger mineral flakes are used as we noted in 1922 (*supra*). In South Georgia diatomaceous *débris* appears to be used to some extent in the construction of the test, contrary to our experience with the "Terra Nova" specimens, in which only mineral matter could be detected (8, p. 67). But it is very difficult to verify the nature of the minute constituents of the test.

Miliammina oblonga is probably the commonest and most characteristic rhizopod of the South Georgia area, occurring in more or less abundance in

nearly every coastal sounding. It reaches its optimum development, both as to size and numbers, in moderately shallow water. ("Discovery" Station 20, 200 metres, and "William Scoresby" Stations 28, 145 metres; 37, 318 metres; 42, 175 metres; 50, 230 metres.) But occasional small specimens have been found down to 1752 metres ("William Scoresby" Station 68), beyond which depth it has not been seen in any of the soundings examined.

The species is subject to considerable variation, mainly owing to differences in the rotundity of the tubular chambers with corresponding changes in the sutural depressions and peripheral angles. As the Antarctic coastline is approached, there is an increase in the size of the mineral particles, a fact previously noted in the "Terra Nova" material. Very little "Discovery" material from the Antarctic area has been examined yet, but we figure a specimen from "Discovery" Station 180, in the Palmer Archipelago (fig. 6), in which the resemblance to its porcellaneous isomorph *Miliolina oblonga* (Montagu) is very pronounced, the sutures being almost flush and the peripheral edge sub-acute, the resemblance being increased by the polished and nearly white test which is characteristic of this station, where the species is common.

Miliammina oblonga appears to be generally distributed in the Antarctic, as the records now extend from the Ross Sea, in the extreme east (Chapman and Heron-Allen & Earland) via Kerguelen Island (H.-A. & E.) to South Georgia, the South Shetlands and the Palmer Archipelago in the west. It does not occur in the Falkland Islands area, which, although not far to the north of South Georgia in latitude, is well outside the extreme limit of the pack-ice within which South Georgia lies. It frequently occurs in association with various porcellaneous *Miliolinae*, contrary to Chapman's experience (7).

MILIAMMINA OBLIQUA sp. nov.

Plate, figs. 7-12.

Test quinqueloculine, with tubular chambers broader at the aboral ends, the early chambers lying transversely across the centre of the test. Sutural lines depressed and peripheral edge rounded. Aperture crescentiform, usually flush with the terminal end of the test, sometimes on a slightly produced neck with collar, furnished with a minute simple tooth. Walls thin and smooth, sometimes polished, embodying fine mineral grains which appear to be somewhat larger than in *M. oblonga*. Colour varying from nearly white to dark grey, occasionally brownish. Size variable, but never attaining the proportions of *M. oblonga*. Average length, 0.30-0.35 mm., breadth 0.15-0.18 mm., thickness 0.12 mm.

This little form, which frequently, but not invariably, occurs in company with *M. oblonga*, differs from that species mainly in the transverse disposition of the central chambers. It may be considered isomorphous with *Miliolina*

bosciana (d'Orbigny), and occupies the same position with regard to *Miliammina oblonga* as *Miliolina bosciana* does to *Miliolina oblonga* (Montagu). Its distribution is probably co-extensive with that of *Miliammina oblonga*, as it was found in the "Terra Nova" material and at Kerguelen Island.

We have not had an opportunity of examining Fauré-Fremiet's specimens of *Miliolina alveoliniformis* Brady,* but his figure shows transverse central chambers, and it seems not improbable that it represents a local variety of *Miliammina obliqua*. The chief difference appears to lie in the cribrate aperture on a produced neck, which may be either a local variation or possibly a semi-ingested food mass clogging the normal aperture. The external surface also seems much rougher than any specimens we have seen, and the dimensions given, 0.5–0.6 mm. (length assumed), are larger than any specimens we have seen.

MILIAMMINA LATA sp. nov.

Plate, figs. 13–17.

Test quinqueloculine, but frequently with very little exposure of the earlier chambers, so little, in fact, that to a casual inspection the test appears triloculine. Chambers inflated, broadening at the aboral end, broadly rounded at the periphery. Sutural lines flush or only slightly depressed. Aperture rather small, crescentiform, with slightly reverted collar, situated on the end of terminal chamber, never on a produced neck, furnished with a simple tooth. Wall rather thick, smooth, rarely polished, containing fine mineral particles in an excess of siliceous cement. Colour light grey. Size varying between 0.30–0.45 mm. in length, 0.20–0.32 mm. in breadth, 0.13–0.22 mm. in thickness.

This is a very distinctive species, and may be considered isomorphous with *Miliolina subrotunda* (Montagu). In the South Georgia area it is much rarer than either *M. oblonga* or *M. obliqua*, having been obtained at only seven stations in depths ranging between 183 and 818 metres, always in company with one or both of the other species. In the "Discovery" Antarctic

* Since the above paragraph was set up in type we have heard from Prof. F. Fauré-Fremiet, to whom we had applied for information respecting his types. We regret to learn that he has abandoned the study of the Foraminifera, being fully occupied with his duties as Professor and Director of the Laboratory of Comparative Embryology at the Collège de France, Paris. He informs us that his mounted specimens of *Miliolina alveoliniformis* Brady have been mislaid, and are probably lost, but, having refreshed his memory by reference to his paper, he has no doubt whatever that his figure No. 5b represents the oral end of his specimens, and that the characteristics there shown were constant and apparently quite distinct from the normal milioline aperture.

We must therefore accept the position that, in addition to the four species of *Miliammina* described in this paper, there is a fifth species in the Antarctic answering to Fauré-Fremiet's description and figures, and characterised by a cribrate aperture. As the attribution of the "Pourquoi-Pas?" specimens to *Miliolina alveoliniformis* Brady cannot be upheld, we suggest the name *Miliammina cribrata* for Fauré-Fremiet's type.

material it has so far been recognised only at Station 180, in the Palmer Archipelago, where it attains somewhat larger dimensions, up to 0.50 mm. long, 0.42 mm. broad, and occurs in company with *M. oblonga*, *M. obliqua* and *M. circularis*. It bears considerable superficial resemblance to the last species, but is distinguishable owing to the definitely triloculine arrangement of chambers, larger size and peculiar surface texture of *Miliammina circularis*.

Miliammina lata occurs at seven of the ten "Terra Nova" stations from which we recorded *Miliolina oblonga* var. *arenacea*, so it may be presumed that the species is universally distributed in the Antarctic, like *M. oblonga* and *M. obliqua*.

We figure an abnormal specimen from "William Scoresby" Station 50, in 230 metres, characterised by the prolongation of the final chamber into an enveloping curve terminated by a very large aperture (fig. 17). Such abnormalities are of frequent occurrence in gatherings of its porcellanous isomorph *Miliolina subrotunda* (Mont).

MILIAMMINA CIRCULARIS sp. nov.

Plate, figs. 18-21.

Test triloculine, with swollen chambers and depressed sutures. Aperture large and crescentiform on the extremity of the final chamber, flush or provided with a slightly reverted collar, furnished with a small simple tooth. Colour dirty white to light grey. Surface unpolished, smooth to eroded in texture, the surface being covered with innumerable very minute depressions. Wall apparently thick and solid, but no broken specimens seen or sections made, homogeneous in texture, the mineral particles being extremely small and buried in an excess of cement. Length 0.75-0.90 mm., breadth 0.60 mm., thickness 0.55 mm.

Four specimens were found in a gathering made in Schollaert Channel, Palmer Archipelago ("Discovery" Station 182), depth 278-500 metres. Very little material from these southern stations has been examined yet, and nothing more can be said at present as to the distribution of the species.

Miliammina circularis may be regarded as an isomorph of the porcellanous species *Miliolina circularis* (Bornemann), to which it bears remarkable similarity in contour. Its white colour and characteristic surface like frosted glass give it an extraordinary resemblance to a *Miliolina*, and its agglutinate character was not at first suspected. Examination of the surface under greater magnification revealed the constituent mineral grains, and the acid test then proved the siliceous nature of the organism.

The types of the species described in this paper are in the Heron-Allen & Earland Collection, British Museum (Natural History), London. Paratypes are in the Cabinet of the Royal Microscopical Society.

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DESCRIPTION OF PLATE.

- Fig. 1.—*Miliammina oblonga* (Chapman). Front view. × 50.
 Fig. 2.—*Miliammina oblonga* (Chapman). Back view. × 50.
 Fig. 3.—*Miliammina oblonga* (Chapman). Edge view. × 50.
 Fig. 4.—*Miliammina oblonga* (Chapman). Oral view. × 50.
 Fig. 5.—*Miliammina oblonga* (Chapman). Front view. × 50.
 Fig. 6.—*Miliammina oblonga* (Chapman) var. isomorphous with *Miliolina oblonga* Montagu. Front view. × 50.
 Fig. 7.—*Miliammina obliqua* sp. nov. Front view. × 50.
 Fig. 8.—*Miliammina obliqua* sp. nov. Front view. × 50.
 Fig. 9.—*Miliammina obliqua* sp. nov. Back view. × 50.
 Fig. 10.—*Miliammina obliqua* sp. nov. Edge view. × 50.
 Fig. 11.—*Miliammina obliqua* sp. nov. Oral view. × 50.
 Fig. 12.—*Miliammina obliqua* sp. nov. (young shell). Front view. × 50.
 Fig. 13.—*Miliammina lata* sp. nov. Front view. × 50.
 Fig. 14.—*Miliammina lata* sp. nov. Back view. × 50.
 Fig. 15.—*Miliammina lata* sp. nov. Edge view. × 50.
 Fig. 16.—*Miliammina lata* sp. nov. Oral view. × 50.
 Fig. 17.—*Miliammina lata* sp. nov. (abnormal specimen). Front view. × 50.
 Fig. 18.—*Miliammina circularis* sp. nov. Front view. × 38.
 Fig. 19.—*Miliammina circularis* sp. nov. Back view. × 38.
 Fig. 20.—*Miliammina circularis* sp. nov. Edge view. × 38.
 Fig. 21.—*Miliammina circularis* sp. nov. Oral view. × 38.
 Fig. 22.—*Miliammina oblonga* (Chapman), as a transparent object. Front view. × 50.
 Fig. 23.—*Miliammina oblonga* (Chapman), as a transparent object. Edge view. × 50.

VII.—THE FORAMINIFERA OF THE PLYMOUTH DISTRICT.

I.

By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.

(Read November 20, 1929).

THREE PLATES.

THERE are probably but few districts round the British coasts, so restricted in area as that adjacent to Plymouth, from whence an equally extensive series of foraminifera might be recorded. We were not unfamiliar with the general *facies*, having already published a paper (H.-A. & E., 1916, FSC) on the Foraminifera of South Cornwall, in which the most easterly station dealt with was Whitsand Bay, which is the most westerly station dealt with in the present work. The greater supply of material now at our disposal has enabled us considerably to extend the list given in that paper, but some species then recorded will not be found in the present list. The absence of some of these species is probably due to the different character of many of the Cornish gatherings, which were for the most part shore-sands, but there are other species missing which might reasonably have been expected to occur in the present gatherings.

The Plymouth district has already formed the subject of a paper by R. H. Worth (Journ. Marine Biol. Assoc., vol. vii, 1904, pp. 174–85), in which some 116 species were recorded. Some of these we have not found, and a few others we hesitate to accept without verification of the actual specimens. Unfortunately, these are not available, and in a preliminary list, delivered to the Marine Biological Laboratory, we have included them with reservation and on his authority only. The present list, which contains only the species observed by ourselves, must not, therefore, be regarded as final, for there are still many species which a collector with more time and opportunities than were available to us may reasonably expect to find in the district, especially in the deeper areas and in shore- and rock-pool collections.

The material upon which the present paper is based was, with the exception of that from Stations 7 and 8, collected by ourselves, or for us by the staff of the Marine Biological Laboratory in April, 1929, and is as follows:—

Station 1.—(Label) “D netting. Inside Drake’s Island. 4 fms. 5 April, 1929.”—This consisted of about 1,000 cc. of flocculent algal *débris* with little sand and mud. The flocculent matter having been elutriated, the residue, after being washed and “floated,” yielded only 4 cc. of material, the whole of which was examined.

Station 2 (a).—A small sample from a tank in the “Easter Class”

Laboratory, in which certain fauna were preserved. (b) A bucketful of fawn-coloured muddy sand, large *Pecten* shells and *débris*. (Label) "Dredging. Eddystone bearing W. by N. $2\frac{1}{2}$ miles. Depth about 30 fms. 10 April, 1929." Washed on a sieve 10 meshes to the inch. The finer material washed on 150-mesh silk and "floated." Result, 10 cc., of which 4 cc. were examined. A second sample (800 cc.) cleaned, "floated," and elutriated. Result, 0.5 cc. "floats," 6.5 cc. of coarse, and 1.5 cc. of fine elutriations. In all, 9 cc. of material from this station were examined.

Station 3.—A shore gathering made by Dr. N. B. Eales in Rum Bay. A black (shale) mud, difficult to clean. Washed on 150-mesh silk, yielding 1.2 cc. of floated material, from which only 33 species were obtained.

Station 4.—(Label) "Eddystone bearing E.S.E. $1\frac{1}{2}$ miles. Fine mesh dredge. About 30–31½ fms. 9 April, 1929." This supply was also unlimited, consisting of a bucket of dark grey organic *débris*, mud and sand. Large shell fragments, principally *Pecten* and whelk. A preliminary examination of 0.5 cc. revealing the richness of the gathering, it was sieved like Station 2 and elutriated, yielding 50 cc. of coarse, 54 cc. of medium, and 4 cc. of fine elutriations. Of these, 8 cc. were examined.

Station 5, Wembury Beach, 10 April, 1929.—A shore gathering made upon patches of sand between rock-pools. 300 cc. of "scrapings," after washing, yielded 11 cc. of "floatings" rich in all the typical English Channel forms, 8 cc. of the material examined yielding 140 species.

Station 6.—A preliminary dredging from Cawsand Bay, 3–4 fms., sent to us in London in March, 1929. About 500 cc. in alcohol, very rich in the commoner forms of foraminifera, and much coal dust. After washing yielded 0.15 cc. of pure, very fine foraminifera. Elutriations in four grades, (1) coarsest, 10 cc., (2) 10 cc., (3) 3 cc., (4) 37 cc. About 12 cc. examined.

Station 7, Whitsand Bay.—Shore gathering made for us by Dr. J. H. Orton in October, 1914. 100 cc. of material washed and "floated," yielding 0.3 cc. of pure foraminifera (included in H.-A. & E., 1926, ESC).

Station 8.—A small quantity of mounted material from the J. J. Lister Collection, remounted and identified by us. It probably came from Station 1, or from Cawsand Bay, which were his two favourite hunting-grounds, where *Polystomella* is particularly fine and prominent.

As we had occasion to remark in our Cornwall paper, derived fossils are very rare in these gatherings, the shore rocks being for the most part Lower Devonian slates and shales, with outcrops of Ordovician rocks heavily veined with massive quartz.

There are many specific and varietal names used in this paper for the first time. Three of these are new to science, viz :—

Hippocrepina pusilla.
Orthocerina bicamerata.
Nonionella auricula.

The following new names are used for species and varieties which have previously been figured without name, or assigned in error to other species. Reasons for the changes appear under their respective headings.

Biloculina elongata var. *quadrata*.

Miliolina cliarensis.

Bolivina pseudo-plicata.

Spirillina vivipara var. *runiana*.

Spirillina wrightii.

Two new specific names will be found for species whose names had been preoccupied by an earlier author. They are :—

Miliolina stelligera (Schlumberger non Terquem), which becomes *M. schlumbergeri*.

Miliolina trigonula (Terquem non Lamarck), which becomes *M. dunkerquiana*.

In addition to the foregoing new species and *nomina nova*, the following 14 species have not been previously recorded as British under these names :—

Biloculina globulus Bornemann.

Miliolina nitida (d'Orb.).

„ *lamarckiana* (d'Orb.).

„ *dilatata* (d'Orb.).

„ *oblonga* var. *lata* (Terquem).

„ *anguina* (Terq.).

„ *badenensis* (d'Orb.).

„ *undulata* (d'Orb.).

„ *disparilis* (d'Orb.).

Lagena catenulata (Reuss).

Polymorphina williamsoni Terquem.

Candeina nitida (d'Orb.).

Discorbina lauriei H.-A. & E.

Truncatulina pygmæa Hantken.

We also adopt Cushman's name *Siphonina tubulosa* for the species hitherto recorded from Britain as *Truncatulina reticulata* (Czjzek, 1848).

The occurrence of such southern forms as *Miliolina nitida* (d'Orb.), *M. disparilis* (d'Orb.), and *Candeina nitida* d'Orb., together with the relative abundance of other species rarely found in British shore sands, appears to be evidence of an extension of distribution, due perhaps to the influx of warm Atlantic water.

In this paper we have adhered to the classification of Brady, with some necessary modifications. With all its admitted weaknesses, it appears to us to be the most suitable for a paper dealing with British foraminifera, all recent literature on that subject having been written under that classification.

For the same reason we retain many generic names which, after universal acceptance during several generations, have recently been abandoned by the American authors, under the Laws of Priority, in favour of other names which have never been used since their original creation.

Sub-Kingdom—Protozoa.

Class—Rhizopoda.

Order—Foraminifera.

Family—Gromiidae.

GROMIA Dujardin.

1. *Gromia oviformis* Dujardin.

Gromia oviformis Dujardin, 1835, Ann. Sci. Nat. Zool. (2), vol. iv., p. 345, pl. ix, figs. 1, 2.

Gromia oviformis Dujardin, 1841, Hist. Nat. Zooph. Infusoires, p. 253, pl. i, fig. 16.

Gromia oviformis Rhumbler, 1903, ZRR, p. 203, fig. 18.

Stations 3, 5.

At these stations, clinging to the rocks and the algæ at moderate depths, were a considerable number of gromid bodies which were clearly the *G. oviformis* of Dujardin (*ut supra*), *G. dujardinii* M. Schultz (S. 1854, O.P., p. 18, pl. vii, figs. 1–7) and *Hyalopus dujardinii* (Schultze) of Schaudinn (Sitzb. Ges. Nat. Fr. Berlin, 1894, pp. 14–22), which, as Rhumbler (*ut supra*) pointed out, are identical organisms. Margaret W. Jepps, who collected at Millport and at Plymouth (Cawsand Bay, 2–4 fms., our Station 6) and published a valuable paper on the organism in the Q.J.M.S. (vol. 70, pt. iv, 1926, pp. 701–19, pls. 37–9), has usefully separated the larger oval forms from the smaller spherical forms. We have cultivated the latter form in our tanks at Selsey, and our observations were published in the Phil. Trans. Roy. Soc. (1915, B., vol. 206, pp. 231–2, pls. 13, 14). It is a question whether Dujardin's original form (1835) was a true foraminifer, the pseudopodia being *filose* and not *reticulose*. This question has been fully discussed by Rhumbler and by Margaret Jepps. Both forms were present in our gatherings at Plymouth, and we need not elaborate the discussion here.

Sub-Family—Nubeculariinae.

NUBECULARIA Defrance.

2. *Nubecularia lucifuga* Defrance.

Nubecularia lucifuga Defrance, 1825, Diet. Sci. Nat. (Strasburg, 1816–30), vol. xxxv, p. 210; Atlas Zooph., pl. xlv, fig. 3.

Nubecularia lucifuga Heron-Allen & Earland, 1915, FSC., p. 34, pl. v, figs. 1, 2.

Station 2.

At this station several specimens occurred bearing a marked resemblance to the tubular form which we recorded from South Cornwall (Stations 1, 2 and 5). The bifurcation is not so marked, but the relationship is unmistakable.

Sub-Family—Miliolininæ.

BILOCULINA d'Orbigny.

3. *Biloculina depressa* d'Orbigny.

Biloculina depressa d'Orbigny, 1826, TMC., p. 298, No. 7, Modèle No. 91.

Biloculina ringens, var. *carinata* Williamson, 1858, RFGB, p. 79, figs. 172-4.

Biloculina depressa Brady, 1884, FC, p. 145, pl. ii, figs. 12, 15-17, pl. iii, figs. 1, 2.

Stations 2, 4, 5, 7, 8.

Common at Stations 2 and 4. Very rare at Stations 5 and 7. The finest specimens at Station 2.

4. *Biloculina elongata* d'Orbigny.

Biloculina elongata d'Orbigny, 1826, TMC, p. 298, No. 4.

Biloculina ringens var. *patagonica* Williamson, 1858, RFGB, p. 80, figs. 175, 176.

Biloculina elongata Terquem, 1882, FEP, p. 154, pl. xvi (xxiv), s. 1, a, b.

Stations 2, 4, 6.

Rare at all the stations. Among the specimens from Station 2 were several individuals referable to d'Orbigny's *B. patagonica* (d'O., 1839, FAM, p. 65, pl. iii, figs. 15-17). This is generally regarded as a synonym of *B. elongata*, and we do not think it worth while to separate them. Var. *patagonica* is pear-shaped, narrower at the oral extremity.

5. *Biloculina elongata* var. *quadrata*, nov.

Plate II, figs. 1-4.

Biloculina elongata Heron-Allen & Earland, 1916, FSC, p. 34, pl. v, figs. 3-5.

Station 2.

The very distinctive form which we figured from Mounts Bay (25-40 fms.), *ut supra*, occurs at Station 2, and appears to be worth a varietal name, as we cannot identify it with any published figure. As will be seen from the

new figures of the Plymouth specimens, its oral aperture resembles that of *B. vespertilio* Schlumberger even more than that of *B. ringens*, with which we previously compared it. But there the resemblance ends, for *B. vespertilio* (Schlumberger, 1891, BGF, p. 561*, pl. x, figs. 74-6, text-figs. 20-2; Cushman, 1910, etc., FNP, 1917, p. 77, pl. xxx, fig. 1, text-figs.) is circular in outline and nearly globular in section, whereas our variety is quadrate and flattened.

Dimensions: length 0.8-0.9 mm.; breadth 0.6 mm.; thickness 0.3-0.4 mm.

* Most synonymies give "p. 174." This arises from the deplorable custom adopted by Schlumberger of having all his reprints paged consecutively. This must always be borne in mind. See the "List of Works" at the end of this paper.

6. *Biloculina globulus* Bornemann.

Biloculina globulus Bornemann, 1855, FSH, p. 349, pl. xix, fig. 3.

Biloculina globulus Schlumberger, 1891, BGF, p. 575*, pl. xii, figs. 97-100, text-figs. 42-4.

Station 8 (*New to Britain*).

A single specimen.

SPIROLOCULINA d'Orbigny.

7. *Spiroloculina acutimargo* Brady.

Spiroloculina acutimargo Balkwill & Wright, 1883, DIS, p. 323, figs. 1, a-c.

Spiroloculina acutimargo Brady, 1884, FC, p. 154, pl. x, figs. 13 and 15.

Spiroloculina acutimargo Heron-Allen & Earland, 1913, CI, p. 24, pl. i, fig. 8.

Stations 2, 4.

A few minute specimens only at each station, similar to those figured by Balkwill and Wright and ourselves from Irish waters.

8. *Spiroloculina planulata* (Lamarck).

Miliolites planulata Lamarck, 1804, AM, p. 352, No. 4; Lamarck, 1816, etc., ASV, vol. vii, p. 613, No. 4.

Spiroloculina planulata Brady, 1884, FC, p. 148, pl. ix, fig. 11.

Stations 2, 4, 5.

The specimens are not very distinctive. An abnormal (wild-growing) specimen at Station 5.

* See note to No. 5.

9. Spiroloculina canaliculata d'Orbigny.

Spiroloculina canaliculata d'Orbigny, 1846, FFV, p. 269, pl. xvi, figs. 10-12.

Spiroloculina canaliculata, Jones, Parker & Brady, 1866, etc., MCF, p. 16, pl. iii, figs. 39, 40.

Stations 1, 4, 5.

Very rare and not very distinctive, but clearly attributable to this species.

10. Spiroloculina dorsata Reuss.

Spiroloculina limbata Bornemann, 1855, FSH, p. 348, pl. xix, fig. 1.

Spiroloculina dorsata Reuss, 1870, FSP, p. 464; von Schlicht, 1870, FSP, p. 97, pl. xxxvii, figs. 24-32.

Stations 2, 5.

Very good specimens at Station 2, though generally distinguishable with difficulty from *S. planulata*. The species must be of frequent occurrence, though hitherto only recorded by us from Cornwall and the West of Scotland.

11. Spiroloculina limbata d'Orbigny.

"*Frumentaria Sigma et Rhombos*" Soldani, 1798, Testaceographia, vol. ii, p. 54, pl. xix, fig. m.

Spiroloculina limbata d'Orbigny, 1826, TMC, p. 299, No. 12.

Spiroloculina limbata Heron-Allen & Earland, 1915, etc., FKA, p. 553, pl. xl, figs. 14-17.

Stations 2, 4.

Rare but typical.

12. Spiroloculina excavata d'Orbigny.

Spiroloculina excavata d'Orbigny, 1846, FFV, p. 271, pl. xvi, figs. 19-21.

Spiroloculina excavata Brady, 1865, RFND, p. 93, pl. xii, fig. 1.

Stations 2, 4, 5, 7, 8.

The specimens, which are abundant, exhibit the usual tendency to pass into *S. limbata*.

MILIOLINA Williamson.

13. Milliolina circularis (Bornemann).

Triloculina circularis Bornemann, 1855, FSH, p. 349, pl. xix, fig. 4.

Triloculina circularis Jones, Parker & Brady, 1866, etc., MFC, 1895, p. 121, pl. v, fig. 4.

Milliolina circularis Brady, 1884, FC, p. 169, pl. iv, fig. 3, pl. v, figs. 13, 14 (?).

Stations 1-4, 6-8.

Generally rare, more frequent at Station 6.

14. *Milliolina valvularis* (Reuss).

Triloculina valvularis Reuss, 1851, FSUB, p. 85, pl. vii, fig. 56.

Milliolina valvularis Brady, 1884, FC, p. 161, pl. iv, figs. 4, 5.

Stations 2, 4-7.*

Very rare at all the stations.

15. *Milliolina dilatata* (d'Orbigny).

Quinqueloculina dilatata d'Orbigny, 1839, FC, p. 192, pl. xi, figs. 28-30.

Quinqueloculina dilatata Schlumberger, 1893, MGM, p. 75, text-figs. 29, 30, pl. iii, figs. 70-4, pl. iv, figs. 87-90.

Milliolina dilatata Heron-Allen & Earland, 1914-15, FKA, p. 559.

Stations 2, 5, 6 (*New to Britain*).

This is a convenient name under which to separate the flattened forms of *M. subrotunda* having prominent curved outer chambers. The specimens at Plymouth are rare compared with the massive and inflated types of *M. subrotunda*, which are very abundant.

16. *Milliolina labiosa* (d'Orbigny).

Triloculina labiosa d'Orbigny, 1839, FC, p. 178, pl. x, figs. 12-14.

Milliolina labiosa Millett, 1898, etc., FM, 1898, p. 502, pl. xi; figs. 8, 9.

Stations 2, 8.

Very rare, but good specimens.

17. *Milliolina subrotunda* (Montagu).

Vermiculum subrotundum Montagu, 1808, TB, pt. 2, p. 521.

Milliolina subrotunda Brady, 1884, FC, p. 168, pl. v, figs. 10, 11.

Stations 1-8.

Abundant and in all possible variations, monstrous forms occurring at Station 1.

18. *Milliolina seminuda* (Reuss).

Quinqueloculina seminuda Reuss, 1865-6, FABS, p. 125, pl. i, fig. 11.

Quinqueloculina seminuda Terquem, 1878, FIR, p. 76, pl. ix (xiv), figs. 8, a-c.

Milliolina subrotunda var. Wright, 1885-6, BLP, p. 819, pl. xxvi., figs. 5, a-d.

Stations 2, 4-8.

Rather rare, but good specimens, which exhibit considerable range in the strength and number of the peripheral costæ.

19. *Miliolina trigonula* (Lamarek).

Miliolites trigonula Lamarek, 1804, etc., AM, 1804, vol. v, p. 351, No. 3.

Miliolites trigonula Lamarek, 1816, etc., ASV, vol. vii, p. 612; 1835, etc., vol. xi, p. 290, No. 3.

Triloculina trigonula d'Orbigny, 1826, TMC, p. 299, No. 1, pl. xvi, figs. 5-9, Modèle No. 93.

Miliolina trigonula Williamson, 1858, RFGB, p. 84, pl. vii, figs, 180-2.

Stations 1, 3, 5.

The finest and most typical specimens occurred at Station 5. At Stations 1 and 3 abnormal specimens are of frequent occurrence, assuming various forms, some almost biloculine, others having irregular chambers and an aperture in the form of a slit across the top of the final chamber, without the tooth that characterises the normal specimens. These variations are probably due to changes of salinity during the growth of the organism. Dr. J. H. Orton informs us that the surface salinity (which will affect the shore region) is very low, varying from 25.37 p.c. to 32.81 p.c., whilst at the same time bottom salinities, in about 8 fms., varied from 31.82 p.c. to 34.39 p.c. The salinity on the bottom (Station 1) is subject to fluctuations from about 31 to 35 p.c., with a tendency to the higher values.

20. *Miliolina tricarinata* (d'Orbigny).

Triloculina tricarinata d'Orbigny, 1826, TMC, p. 299, No. 7, Modèle No. 94.

Miliolina tricarinata Brady, 1884, FC, p. 165, pl. iii, fig. 17.

Stations 2, 5-8.

Rather rare and small, the largest at Station 8.

21. *Miliolina nitida* (d'Orbigny).

Triloculina nitida d'Orbigny, 1839, FIC, p. 141, pl. iii, figs. 22-4.

Triloculina nitida Brady, 1884, FC, p. 160, sub *M. gracilis* (d'Orb.).

Station 8 (*New to Britain*).

A few specimens which are as near to d'Orbigny's figure of his species from the Canary Islands as anything we can trace. They are hardly strong enough to be assigned to the *Triloculina laevigata* of d'Orbigny, which is a Mediterranean species well known from the researches of Schlumberger,

who revived d'Orbigny's name (previously a *nomen nudum*) in 1898. But the name *laevigata* had in the meantime been used for another form by Bornemanh (B., 1855, FSH, p. 350, pl. 19, fig. 5), so that the exact taxonomical position of the Mediterranean species is somewhat vague.

22. *Milliolina bosci* (d'Orbigny).

Quinqueloculina bosci d'Orbigny, 1839, FC, p. 191, pl. xi, figs. 22-4.

Milliolina bosci Millett, 1898, etc., FM, 1898, p. 267, pl. vi, fig. 1.

Stations 1-8.

Good and typical specimens are of frequent occurrence.

23. *Milliolina oblonga* (Montagu).

Vermiculum oblongum Montagu, 1803, TB., p. 522, pl. xiv, fig. 9.

Milliolina seminum var. *oblonga* Williamson, 1858, RFGB, p. 86, pl. vii, figs. 186, 187.

Milliolina oblonga Heron-Allen & Earland, 1913, CI, p. 25.

Stations 1-8.

Common and exhibiting considerable range of size and form. Generally present in the type of Montagu, with slightly produced neck and normal aperture, but the variety of Williamson, in which the "tooth" is expanded and forms a stopper almost closing the mouth, occurs at Stations 2 and 8.

24. *Milliolina oblonga* var. *lata* (Terquem).

Plate II, figs. 12-15.

Quinqueloculina lata Terquem, 1875-6 (1876), APD, p. 82, pl. xi, figs. 8, a, b.

Stations 1, 2, 4-8 (*New to Britain*).

Terquem's species is a feature of the gatherings, and is the predominant Miliolid at Station 2. Its quadrangular form and highly polished surface, so smooth that the sutural lines are not easily distinguishable, render it a striking object, and worthy of varietal recognition. Our artist has to some extent failed to bring out the features of the surface and its texture.

Terquem's description is as follows :—

"Test elongated oval, oval in section, smooth and highly polished, anteriorly truncated, posteriorly and circumferentially rounded. Formed of chambers straight at the sides and very arched, as if bent, at the back. Slightly sinuous at the sutures; three depressed chambers on one face, four rather more prominent on the other. Aperture thick-walled, small, rounded, and furnished with a simple straight tooth."

Dimensions: length 0.7 mm.; breadth 0.35 mm.; thickness 0.2 mm.

25. *Milliolina vulgaris* (d'Orbigny).

Quinqueloculina vulgaris d'Orbigny, 1826, TMC, p. 802, No. 38.

Quinqueloculina vulgaris Schlumberger, 1893, MGM, p. 65, pl. ii, figs. 65, 66 and woodcuts 13, 14.

Stations 1, 3, 5.

Very rare but typical. An abnormal specimen from Station 5 has the final chamber diverted at right angles to the normal axis and enveloping some of the earlier chambers.

26. *Milliolina seminulum* (Linné).

Serpula seminulum Linné, 1767, SN (ed. xii), p. 1624, No. 791 ; Linné, 1788, SN (ed. xiii), p. 3739, No. 2.

Milliolina seminulum Williamson, 1858, RFGB, p. 85, figs. 183-5.

Stations 1-8.

The true and typical *M. seminulum* is comparatively rare in the gatherings. Some monstrous forms due to varying salinity at Station 2.

27. *Milliolina dunkerquiana*, nom. nov.

Plate II, figs. 9-11.

Quinqueloculina trigonula Terquem (*non* Lamarck), T, 1875, etc., APD, p. 84, pl. xii, figs. 4, *a*, *b*, *c*,

Stations 2, 3, 4.

A plano-convex and highly polished Miliolid, which is a feature of the gatherings, especially at Station 2, presents some difficulty in identification. We are disposed to regard it as identical with the form figured by Terquem from Dunkirk under the name *Quinqueloculina trigonula*, and described by him as follows :—

“Coquille suborbiculaire, lisse, transversalement triangulaire, obtuse sur le pourtour, aplatie en dessous, triangulaire en dessus, formé de loges arquées sur une face, loge médiane très élevé ; sur l'autre face, loges renflées, ouverture très petite, munie d'une dent simple et droite.”

As Terquem's specific name is already preoccupied for the triloculine species of Lamarck, it is necessary to rename the form, which we have done, after its original locality.

The affinities of the species appear to be with *M. seminulum*. The external arrangement of the chambers is distinctly suggestive of *Sigmoilina*, but was found to be regularly quinqueloculine in a number of sections which we made.

Dimensions : length 0.6 mm.; breadth 0.4-0.5 mm.; thickness 0.3-0.35 mm.

28. *Milliolina candeiana* (d'Orbigny).

Plate II, figs. 23-25.

Quinqueloculina candeiana d'Orbigny, 1839, FC, p. 199, pl. xii, figs. 24-6.

Quinqueloculina candeiana Brady, 1870, FTR, p. 286, pl. xi, fig. 1.

Quinqueloculina candeiana Cushman, 1922, Foraminifera of Tortugas, Carnegie Inst., Washington, Publ. 311, p. 65, pl. xii, fig. 1.

There is a single specimen from Station 4 which agrees with d'Orbigny's original figure, except in the fact that the neck is not quite so much produced. So far as we know, this is the only British specimen which can be regarded with any satisfaction.

The British records of the species are not satisfactory. Brady introduced the species to the British fauna in 1870 (*supra*), but his description and figure do not agree with the type, and we have not seen his specimens, so can offer no opinion as to their identity. It was subsequently recorded by Siddall from the Estuary of the Dee, and by Millett from Mounts Bay. We have their collections, but cannot trace the specimens. Our own records from Clare Island, West Scotland, and South Cornwall, were made, under all reservations, on the basis of Brady's figure, and should now be regarded as cancelled. We think it possible that all the British specimens (the Plymouth individual excepted) are immature young of other Miliolidæ, probably *M. angulata* Will.

The specimen measures 0.31 mm. in length by 0.21 mm. in breadth.

29. *Milliolina lamarckiana* (d'Orbigny).

Quinqueloculina lamarckiana d'Orbigny, 1839, FC, p. 189, pl. xi, figs. 14, 15.

Quinqueloculina auberiana d'Orbigny, *ibid.*, p. 193, pl. xii, figs. 1-3.

Miliolina auberiana Brady, 1884, FC, p. 162, pl. v, figs. 8, 9.

Stations 1, 3, 5-8 (*New to Britain under this name*).

Frequent everywhere, but rather small. This common species has hitherto been universally recorded as *M. auberiana*, the earlier diagnosis and figure (according to the strict rules of nomenclature) having been overlooked in the first place, and subsequently ignored.

30. *Milliolina anguina* (Terquem).

Quinqueloculina anguina Terquem, 1878, FIR, p. 78, pl. ix (xiv), figs. 20, a-c.

Quinqueloculina anguina Terquem, 1882, FEP, p. 180, pl. ix (xxvii), s. 20, a, c.

Stations 6, 8 (*New to Britain*).

Very rare. The Plymouth specimens conform in all respects to Terquem's figures, especially to those of 1882.

81. *Miliolina pygmaea* (Reuss).

Quinqueloculina pygmaea Reuss, 1849, FOT, p. 384, pl. i, fig. 8.

Miliolina pygmaea Brady, 1884, FC, p. 163, pl. cxiii, fig. 16.

Stations 1, 2, 6, 7.

A single specimen only at each station.

82. *Miliolina schlumbergeri*, nom. nov.

Plate II, figs. 16-19.

Quinqueloculina stelligera Schlumberger, 1893, MGM, p. 68, pl. ii, figs. 58, 59.

Miliolina stelligera Sidebottom, 1904, etc., RFD, 1904, p. 14.

Stations 2, 7 (*New to Britain*).

Small and very rare, but unquestionably Schlumberger's species, and the first authentic British record. See note to next species, *M. cliarensis*.

The specific name *stelligera* having been preoccupied in 1882 by Terquem (FEP, p. 183), it becomes necessary to rename Schlumberger's species. (See our note on the species in H.-A. & E., 1913, CI, p. 187.)

Dimensions: length 0.31-0.35 mm.; breadth 0.14-0.16 mm.; thickness 0.06-0.1 mm.

83. *Miliolina cliarensis*, sp. nov.

Plate III, figs. 26-31.

Miliolina stelligera Heron-Allen & Earland (*non* Schlumberger), 1913, CI, pp. 31 and 187, pl. i, figs. 14, 15.

Miliolina stelligera Heron-Allen & Earland, 1916, FWS, p. 215, pl. xxxix, figs. 28-31.

Station 7.

Since recording the Clare Island specimens under the name *M. stelligera* Schlumberger, as being the nearest form to which they could be attributed, we have come into possession of co-types of that species, and it is clear that the determination must be revised. The presence of a single specimen of the Clare Island organism at Station 7 gives us the opportunity of doing so. As we have been unable in the interval to identify our specimens with any figured species, we propose to call them after the original locality.

M. cliarensis is characterised by its flattened, non-embracing and curved

chambers, four or five of which are visible on each face, the edges are rather rounded, sometimes acute, neck produced, aperture a straight-edged slit without tooth. The whole shell slopes gradually from the aboral end to the aperture.

The specimens figured in the West Scotland paper represent a well-marked variety characterised by the acute edges of the chambers and by sunken sutures. It is rarer than the type, which occurs sporadically all round our western and southern coasts, and has been noted by us as far south as Esnandes, on the French coast of the Bay of Biscay.

Dimensions : length 0.8-0.45 mm. ; breadth 0.15-0.19 mm.

34. *Milliolina fusca* (Brady).

Quinqueloculina fusca Brady, 1870, FTR, p. 286, pl. xi, fig. 2.

Quinqueloculina fusca Schulze, 1874, R, p. 134, pl. vi, figs. 17-20.

Milliolina fusca Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 576,

A single large individual at Station 3.

35. *Milliolina sclerotica* (Karrer).

Quinqueloculina sclerotica Karrer, 1868, MFKB, p. 152, pl. iii, fig. 5.

Milliolina sclerotica Millett, 1908, FG, p. 4, pl. i, fig. 2 ; 1884, FG, p. 6, pl. i, fig. 2.

Stations 1, 4-8.

As usual, the specimens are with difficulty separable from those of *M. contorta*. On this see H.-A. & E., 1918, CI, p. 30.

36. *Milliolina contorta* (d'Orbigny).

Quinqueloculina contorta d'Orbigny, 1846, FFV, p. 298, pl. xx, figs. 4-6.

Milliolina contorta Halkyard, 1889, RFJ, p. 60, pl. i, fig. 4.

Stations 1-7.

Generally distributed and, as usual, presenting every variation from very rounded to acutely angular forms.

37. *Milliolina badenensis* (d'Orbigny).

Plate II, figs. 20-22.

Quinqueloculina badenensis d'Orbigny, 1846, FFV, p. 299, pl. xx, figs. 10-12.

Station 7 (*New to Britain*).

At this station a few specimens closely resembling d'Orbigny's figure, but slightly broader in proportion to the length. In this respect it is close to the *Quinqueloculina rakosiensis* of Franzenau (1881, Rakoser (Budapest)

Ung. Geol. Gesellsch., vol. xi, 1881, pp. 45 and 98, pl. iii, figs. 7-9). D'Orbigny states that his species is close to *M. contorta*, but the Plymouth specimens, which we figure, differ greatly from the *M. contorta* of this locality.

Dimensions: length 0.25-0.30 mm.; breadth 0.25-0.30 mm.; thickness 0.15 mm.

88. *Miliolina angulata* Williamson.

Miliolina bicornis var. *angulata* Williamson, 1858, RFGB, p. 88, pl. vii, fig. 196.

Miliolina ferussacii Heron-Allen & Earland, 1915, FWS, p. 214, pl. 40, figs. 1-9.

Stations 2, 4, 5, 6, 7.

Williamson's type (*up supra*) has been regarded by Brady and others as a synonym of *M. ferussacii* (d'Orb.), but we have little doubt that the British individuals listed as *M. ferussacii* would more properly have been listed under Williamson's name.

D'Orbigny's species is an Eocene fossil from Paris, and rests upon a Modèle (No. 32). This is "a compressed and almost spiroloculine type, with two strong marginal carinæ and an extra carina on the face of the last chamber; the neck is produced, and the chambers sigmoid in shape" (H.-A. & E., 1914, etc., FKA, 1915, p. 578). The Williamson type is quite distinct from this, and we gave ample figures in our West of Scotland paper (*ut supra*) which might well have been drawn from the Plymouth specimens. These frequently attain magnificent proportions, and range thence down to small tests near *M. undulata* (d'Orb.) *q.v.*

The *M. angulata* Kerrer (*sic*) recorded by David Robertson in "The Raised Sea-Bottom of Fillyside" (Proc. Roy. Phys. Soc., Edin., 1893, vol. 12, pt. 1, p. 27), specimens received from J. Benny (derived from Plymouth), was presumably *Triloculina angulata* Karrer ("Foramfauna in Oesterreich," Sitzb. Ak. Wiss., Wien, vol. lv, 1867, p. 359, pl. ii, fig. 6), and must not be confounded with Williamson's species. They were presumably either *M. lamarckiana* (= *auberiana*) or *M. vulgaris*, both common British forms and bearing some resemblance to Karrer's figure.

NOTE.—The costate Miliolinæ present great difficulties in taxonomic arrangement, as their variations are so extensive. The difficulty can be solved either by the use of a great many so-called specific names, or by the assignment of the variations to a few selected species, using these latter mainly as *foci* for the collection of converging variations. The difficulty is not diminished by the fact that some species exhibit a young *Adelosina* stage, while others do not. Schlumberger has proved that *Adelosina* is merely the megalospheric form, the microspheric form of the same species being normally quinqueloculine.

In the present paper we use *Miliolina bicornis* (W. & J.) as a pivot species.

Miliolina laevigata (d'Orb.) may be regarded as a smooth form of this ; in the Adelosine stage they cannot be separated. Megalospheric individuals of *M. bicornis* are readily distinguishable, even when the adelosine chamber is concealed, by their regularly costate and curved chambers. Microspheric specimens of *M. bicornis* are not so easily diagnosed. They run insensibly into *M. brongniartii*, whence the more undulate varieties pass into *M. undulata* (d'Orb.), and the regular finely costate forms into *M. boueana* (d'Orb.). In the Plymouth gatherings it is quite easy to pick out specimens assignable with comparative certainty to any of the foregoing types, and just as easy to select others of which it can only be said that they are intermediate between two or more of them.

39. *Miliolina (Adelosina) laevigata* (d'Orbigny).

Adelosina laevigata d'Orbigny, 1826, TMC, p. 304, No. 1.

Adelosina laevigata d'Orbigny, 1846, FFV, p. 302, pl. xx, figs. 22-4.

Adelosina laevigata Terquem, 1875, etc., APD, 1876, p. 86, pl. xii, figs. 11a, b.

Miliolina laevigata Heron-Allen & Earland, 1914, CI, p. 32, pl. i, figs. 12, 13.

Stations 1, 5.

A few small specimens only. Several megalospheres also which may belong either to this species or to *M. bicornis*.

40. *Miliolina bicornis* (Walker & Jacob).

Serpula bicornis Walker & Jacob, 1798, AEM, p. 683, pl. xiv, fig. 2.

Miliolina bicornis Williamson, 1858, RFGB, p. 87, pl. vii, figs. 190-4.

Stations 1, 2, 4, 5, 7, 8.

Some large and fine specimens at Stations 1, 5, 8, equal to any Mediterranean specimens. Smaller and weaker at the other stations.

41. *Miliolina brongniartii* (d'Orbigny).

Triloculina brongniartii d'Orbigny, 1826, TMC, p. 300, No. 23.

Triloculina brongniartii Parker, Jones & Brady, 1859, etc., NF, 1871, p. 250, pl. viii, fig. 9.

Miliolina brongniartii Heron-Allen & Earland, 1913, CI, p. 33 ; 1915, etc., FKA, p. 580 ; 1922, TN, p. 70.

Stations 2, 4-7.

Very good at Stations 2, 4, 5.

42. *Milliolina undulata* (d'Orbigny).

Quinqueloculina undulata d'Orbigny, 1826, TMC, p. 302, No. 27.

Miliolina undulata Schlumberger, 1893, MGM, p. 213, pl. i, figs. 53, 54, pl. ii, figs. 60, 61, text-figs. 23, 24.

Miliolina undulata Heron-Allen & Earland, 1914-15, FKA, p. 573, pl. xliii, figs. 5-8.

Stations 2, 4, 5 (*New to Britain*).

A few small specimens only, best at Station 2.

43. *Milliolina boueana* (d'Orbigny).

Quinqueloculina boueana d'Orbigny, 1846, FFV, p. 293, pl. xix, figs. 7-9.

Miliolina boueana Brady, 1884, FC, p. 173, pl. vii, fig. 13.

Stations 1, 2, 4, 5.

Magnificent specimens at Station 2, weaker elsewhere.

44. *Milliolina disparilis* (d'Orbigny).

Plate II, figs. 5-7.

Quinqueloculina disparilis d'Orbigny, 1826, TMC, p. 302, No. 21.

Quinqueloculina disparilis Schlumberger, 1893, MGM, p. 70, pl. ii, figs. 55-7, text-figs. 21, 22.

Station 1 (*New to Britain*).

One good specimen, which we figure. It is a common Mediterranean species.

Dimensions : length 1.5 mm. ; breadth 0.675 mm.

45. *Milliolina pulchella* (d'Orbigny).

Quinqueloculina pulchella d'Orbigny, 1826, TMC, p. 303, No. 42.

Miliolina pulchella Brady, 1884, FC, p. 174, pl. vi, figs. 13, 14 ; pl. ili, figs. 10-13.

Stations 1-4.

A single specimen at each. The species was recorded by Millett from Mounts Bay (Trans. Penzance Nat. Hist. Soc., 1884-5, p. 27), but it is very rarely found in shore-sands and, as a British form, very rare even in dredgings.

MASSILINA Schlumberger.

46. *Massilina secans* (d'Orbigny).

Quinqueloculina secans d'Orbigny, 1826, TMC, p. 808, No. 48, Modèle No. 96.

Miliolina seminulum var. *disciformis* Williamson, 1858, RFGB, p. 86, figs. 188, 189.

Massilina secans Schlumberger, 1893, MGM, p. 76, woodcuts figs. 81-4, pl. iv, figs. 82, 83.

Stations 1, 3, 5, 6, 7, 8.

Universally distributed, often attaining relatively enormous sizes, and presenting, especially at Station 2, every kind of contortion and abnormality due to variations in salinity (Cf. H.-A. & E., 1920, VP, p. 166, pl. xvi, figs. 86-44.).

47. *Massilina secans* var. *denticulata* Costa.

Quinqueloculina denticulata Costa, C, 1853, etc., PRN, p. 325, pl. xxv, fig. 6a, b, c.

Massilina secans Schlumberger, 1893, MGM, p. 76, pl. iv, figs. 82, 83.

Stations 1, 5.

A single very weak specimen at each station.

48. *Massilina secans* var. *tenuistriata* Earland.

Massilina secans var. *tenuistriata* Earland, 1905, FBS, p. 198, pl. xi, fig. 5.

Massilina secans var. *tenuistriata* Heron-Allen & Earland, 1908, etc., SB, 1909, p. 317, and 1910, p. 693; 1914-15, FKA, p. 582, pl. xlv, figs. 28-31.

Stations 2, 3.

A single specimen, very weak, at each.

Sub-Family—Hauerininæ.

OPHTHALMIDIUM Zwingli and Kübler.

49. *Ophthalmidium carinatum* Balkwill & Wright.

Ophthalmidium carinatum Balkwill & Wright, 1885, DIS, p. 326, pl. xii, figs. 18-16.

Ophthalmidium carinatum Heron-Allen & Earland, 1913, CI, p. 34.

Station 2.

A single typical specimen.

PLANISPIRINA Seguenza.

50. *Planispirina cliarensis* Heron-Allen & Earland.

Planispirina cliarensis Heron-Allen & Earland, 1913, CI, p. 35, pl. ii, figs. 7, 8.

Planispirina cliarensis Heron-Allen & Earland, 1922, TN, p. 73.

Station 7.

A single typical specimen from Whitsand Bay. We recorded (in FSC) a similarly isolated specimen from St. Mawes.

CORNUSPIRA Schultze.

51. *Cornuspira involvens* (Reuss).

Operculina involvens Reuss, 1849-50, FOT, p. 370, pl. i (xlvi), fig. 20 (not 30).

Cornuspira involvens Reuss, 1868, KTF, p. 39, pl. i, fig. 2.

Stations 1, 2, 4-7.

All the specimens are small and megalospheric

52. *Cornuspira selseyensis* Heron-Allen and Earland.

Cornuspira (?) Earland, 1905, FBS, p. 199, pl. xiii, figs. 2-4.

Cornuspira selseyensis Heron-Allen & Earland, 1908, etc., SB, 1909, p. 319, pl. xv, figs. 9-11.

Stations 2, 4-7.

All the specimens are small, largest at Stations 5 and 6.

53. *Cornuspira diffusa* Heron-Allen & Earland.

Plate I.

Cornuspira diffusa Heron-Allen & Earland, 1912, etc., NSG, 1913, No. 8, pp. 272-6, pl. xii; 1913, CI, p. 37; 1916, FWS, p. 217.

One fragmentary specimen at Station 6, very small.

We do not agree with Cushman as to the necessity of raising our species to generic rank. In Cont. Cushman Lab. Foram. Research, vol. iv, 1928, p. 4, he constitutes it the genoholotype of his new genus *Cornuspirella*.

In two of J. J. Lister's Plymouth Note-Books (iii, p. 40; iv, p. 70) we find beautiful water-colour drawings of this species from living specimens, with the pseudopodia extended and the protoplasm protruding. He wrote beneath one of them "Fan-shaped Rhizopod," and beneath the other, "20 June '05, length of test about 1 mm.," but he gave it no name, and published no description of it. (See description of plate I.)



Family—Astrorhizidæ.

Sub-Family—Astrorhizinæ.

IRIDIA Heron-Allen & Earland.

54. *Iridia diaphana* Heron-Allen & Earland.

Plate III, figs. 32-33.

Thurammina papillata (?) Earland, 1905, FBS, p. 201, pl. xi, figs. 6, 7 ;
pl. xiv, figs. 1-3.

Webbina hemisphaerica Heron-Allen & Earland, 1908, etc., SB, 1909,
p. 325, pl. xv, fig. 14.

Iridia diaphana Heron-Allen & Earland, 1914, etc., FKA, 1914,
p. 371, pl. xxxvi ; 1915, p. 607 ; 1915, FSC, p. 37 *et seq.*

Stations 4, 5.

A remarkably fine and typical specimen, which we figure, from Station 5.
A less noteworthy one from Station 4. A very full note on this organism
will be found in our Cornwall paper, *ut supra*.

Dimensions of the figured specimen : length 1 mm. ; breadth 0.75 mm.

Sub-Family—Pilulininæ.

BATHYSIPHON G. O. Sars (M. Sars, MS.).

55. *Bathysiphon argenteus* Heron-Allen & Earland.

Bathysiphon argenteus Heron-Allen & Earland, 1913, CI, p. 38, pl. iii,
figs. 1-3 ; 1916, FWS, p. 218.

Station 4.

A single specimen.

Sub-Family—Saccammininæ.

PSAMMOSPHAERA Schulze.

56. *Psammosphaera fusca* Schulze.

Psammosphaera fusca Schulze, 1874, R, p. 113, pl. ii, fig. 8.

Psammosphaera fusca Brady, 1879, etc., RRC, 1879, p. 27, pl. iv,
figs. 1, 2.

Stations 1, 2.

Very rare. The most interesting specimens are from Station 1, where
the organism employs fragments of molluscan shells, which give an angular
appearance to the test, somewhat suggestive of *Psammosphaera bowmanni*
(H.-A. & E., 1912, etc., NSG, 1912, p. 385, pl. v, figs. 5, 6, pl. vi, fig. 5).

WEBBINELLA Rhumbler.

57. *Webbinella hemisphaerica* Jones, Parker & Brady.

Webbina hemisphaerica Jones, Parker and Brady, 1866, etc., MFC, 1866, p. 27, pl. iv, fig. 5.

Webbina hemisphaerica Brady, 1884, FC, p. 350, pl. xli, fig. 11.

Webbinella hemisphaerica Rhumbler, 1903, ZRF, p. 228, fig. 54.

One very fine specimen from Station 2 and another from Station 4.

Sub-Family—Rhabdammininæ.

JACULELLA Brady.

58. *Jaculella acuta* Brady.

Jaculella acuta Brady, 1879, etc., RRC, 1879, p. 35, pl. iii, figs. 12, 13.

Jaculella acuta Brady, 1884, FC, p. 255, pl. xxii, figs. 14–18.

Frequent at Station 2, where specimens were found up to 6 mm. in length.

HYPERAMMINA Brady.

59. *Hyperammina elongata* Brady.

Hyperammina elongata Brady, 1878, RRNP, p. 433, pl. xx, fig. 2a, b.

Hyperammina elongata Cushman, 1910, etc., FNP, 1910, p. 60, figs. 73, 74.

Station 2.

Some fragments which we think should be referred to this species.

TOLYPAMMINA Rhumbler.

60. *Tolypammina vagans* (Brady).

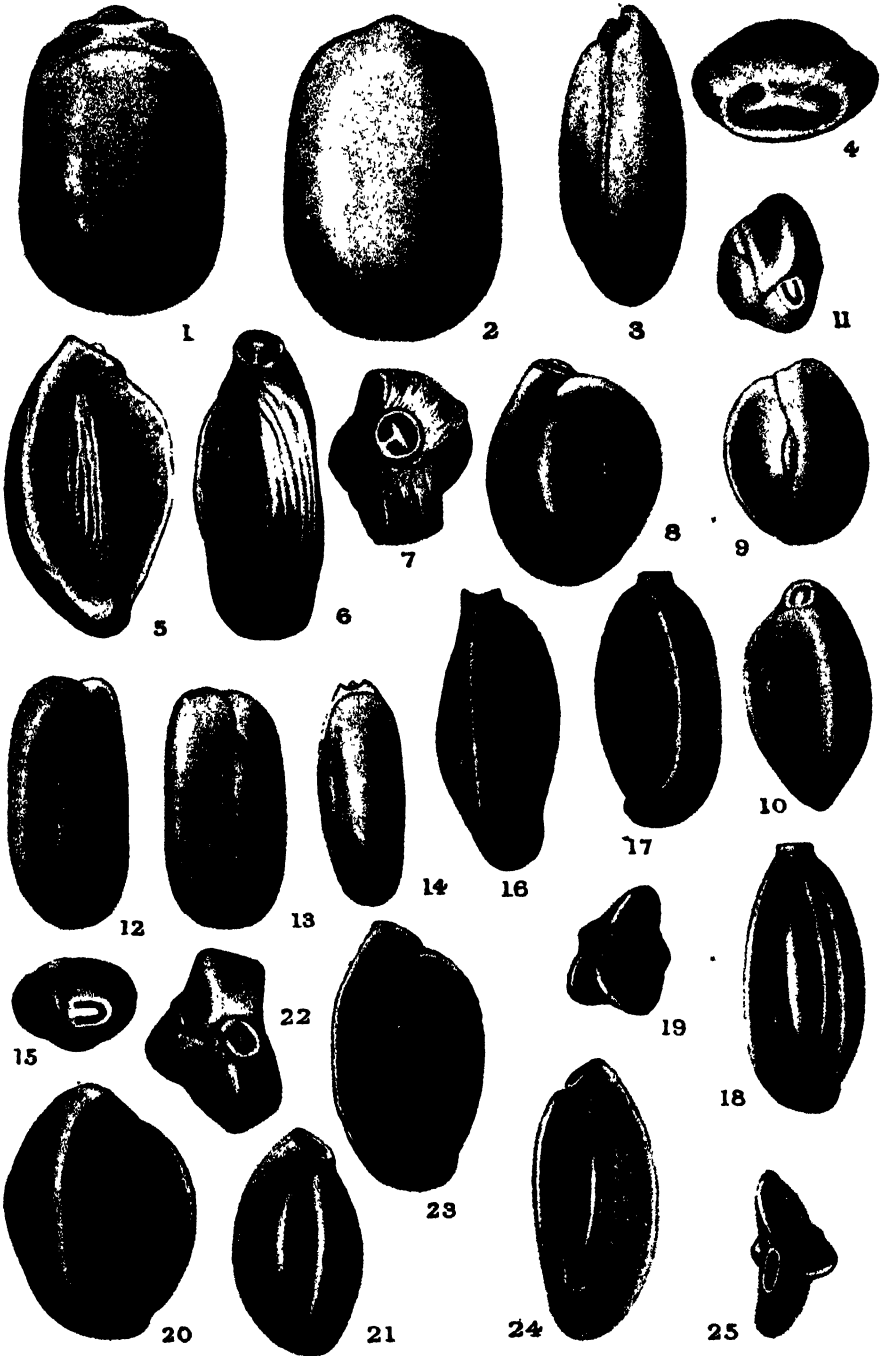
Hyperammina vagans Brady, 1879, RRC, etc., 1879, p. 33, pl. v, fig. 3.

Tolypammina vagans Rhumbler, 1903, ZRR, p. 277, fig. 125a, b.

Hyperammina vagans Heron-Allen & Earland, 1913, CI, p. 41, pl. ii, fig. 9.

Station 2.

One specimen was observed on a dead *Pecten* shell. Probably not uncommon on similar material.



Family—Lituolidæ.

Sub-Family—Lituolinæ.

REOPHAX Montfort.

61. *Reophax difflugiformis* Brady.

Reophax difflugiformis Brady, 1879, etc., RRC, 1879, p. 51, pl. iv, fig. 8.

Reophax difflugiformis Brady, 1884, FC, p. 289, pl. xxx, figs 1-5.

Station 2.

The specimens are not very satisfactory. They may be primordials of *R. scorpiurus*, being constructed of the same angular sand grains.

62. *Reophax fusiformis* (Williamson).

Protonina fusiformis Williamson, 1858, RFGB, p. 1, pl. i, fig. 1.

Reophax fusiformis Millett, 1898, etc., FM, 1899, p. 253, pl. iv, fig. 11.

Reophax fusiformis Heron-Allen & Earland, 1916, FWS, p. 222.

Stations 2, 4.

The best specimens at Station 4.

63. *Reophax scorpiurus* Montfort.

Reophax scorpiurus Montfort, 1808, CS, vol. i, p. 330, 83e genre.

Reophax scorpiurus Cushman, 1910, etc., FNP, 1910, p. 88, figs. 114-16.

Station 2.

The specimens are very roughly constructed of large angular sand grains.

64. *Reophax nodulosa* Brady.

Reophax nodulosa Brady, 1879, etc., RRC, 1879, p. 52, pl. iv, figs. 7, 8 ; 1884, FC, p. 294, pl. xxxi, figs. 1-9.

Reophax nodulosa Cushman, 1910, etc., FNP, 1910, p. 87, fig. 122.

Station 2.

Two fragments only.

65. *Reophax scottii* Chaster.

Reophax nodulosa (?) Scott, 1890, 8th Ann. Report of the Fisheries Board of Scotland, pt. iii, p. 314.

Reophax scottii Chaster, 1892, FS, p. 57, pl. i, fig. 1.

Reophax scottii Millett, 1898, etc., FM, 1899, p. 225, pl. iv, fig. 13.

Stations 1, 6.

A specimen at each station similar to those we recorded from Mounts Bay (35-40 fms.). A specimen had previously been submitted to us for identification by Dr. Marie V. Lebour.

66. *Reophax moniliforme* Siddall.

Reophax ? sp. Balkwill & Wright, 1885, DIS, p. 328, pl. xiii, figs. 9, 22-4.

Reophax moniliforme Siddall, 1886, LMBC, p. 54, pl. i, fig. 2.

Reophax moniliforme Heron-Allen & Earland, 1913, CI, p. 43, pl. ii, fig. 12.

Stations 1, 2, 4, 5.

Very rare, except at Station 2, where numerous well-developed specimens were found, all fragmentary, as is usually the case.

HAPLOPHRAGMIUM REUSS.

67. *Haplophragmium pseudospirale* (Williamson).

Protonina pseudospiralis Williamson, 1858, RFGB, p. 2, pl. i, figs. 2, 3.

Haplophragmium pseudospirale Heron-Allen & Earland, 1916, FWS, p. 223, pl. xl, fig. 4.

Stations 4, 5.

Rare and small.

68. *Haplophragmium canariense* (d'Orbigny).

Nonionina canariensis d'Orbigny, 1839, FIC, p. 128, pl. ii, figs. 33, 34.

Haplophragmium canariense Brady, 1884, FC, p. 310, pl. xxxv, figs. 1-5.

Stations 1, 2, 4-8.

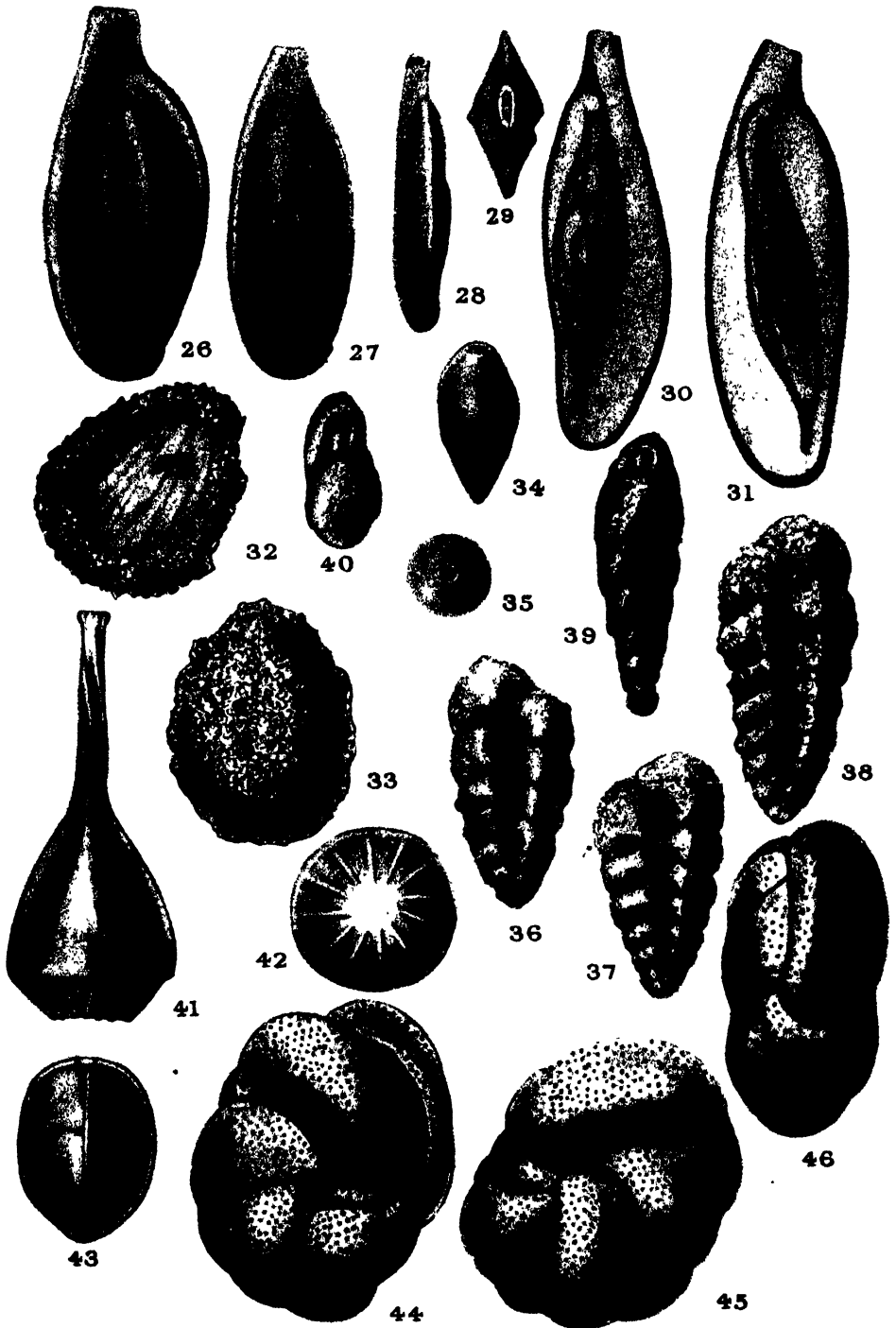
Frequent or common at Stations 4, 6 and 7. Rare elsewhere. No very large individuals were seen; the local form is of a small and neatly constructed type. At Station 1 an abnormal specimen consisting of two individuals joined by the upper peripheral margins, so that the oral apertures are approximately opposite, though widely separated.

69. *Haplophragmium canariense*, var. *variabilis* Heron-Allen & Earland.

Haplophragmium canariense (d'Orb.) Heron-Allen & Earland, 1916, FWS, p. 223, pl. x, figs. 12, 13.

Haplophragmium canariense, var. *variabilis* Heron-Allen & Earland, 1916, FSC, p. 41, pl. vi, figs. 1-3.

A single typical specimen at Station 2, and one broken individual (?) Station 1. Cf. our note on the variety in FSC.



70. *Haplophragmium runianum* Heron-Allen & Earland.

Haplophragmium runianum Heron-Allen & Earland, 1916, FWS, p. 224, pl. xl, figs. 15-18.

A single specimen at Station 6.

71. *Haplophragmium globigeriniforme* (Parker & Jones).

Lituola nautiloidea var. *globigeriniformis* Parker & Jones, 1865, NAAF, p. 407, pl. xv, figs. 46, 47; pl. xvii, figs. 96-8.

Haplophragmium globigeriniforme Brady, 1884, FC, p. 312, pl. xxxv, figs. 10-11.

Trochammina globigeriniformis Cushman, 1910, etc., FNP, 1910, p. 124, figs. 198-5.

Stations 2, 4.

Small but neatly constructed specimens are common.

CRITHIONINA GOES.

72. *Crithionina mamilla* Goes.

Crithionina mamilla Goes, 1894, ASF, p. 15, pl. iii, figs. 34-6.

Crithionina mamilla Millett, 1898, etc., FM, 1899, p. 250, pl. iv, fig. 2.

Station 1.

A single good specimen growing on a crustacean fragment.

Sub-Family—Trochammininae.

HIPPOCREPINA PARKER.

73. *Hippocrepina pusilla* sp. nov.

Plate III, figs. 34-35.

Hippocrepina indivisa Parker, H.-A. & E., 1913, CI, p. 48, pl. 2, figs. 10, 11.

Test monothalamous, rounded at the oral extremity and tapering to an acute point aborally. Aperture variable in size, circular, and normally with slightly incurved rim, sometimes everted. Colour a lustrous grey at oral end, gradually deepening to rusty brown at aboral extremity. Wall very thin, built up of minute mica scales, fragile, but not readily fractured, i.e., the organism becomes distorted before the breaking point is reached.

Length 0.5-0.6 mm.; breadth 0.37-0.4 mm.

Station 2.

Only four specimens of this interesting little form were found. It is very minute, and may have escaped observation elsewhere.

These Plymouth specimens appear to be the same organism as were figured and described by us *ut supra* under the name *Hippocrepina indivisa* Parker. The differences in size, thickness of wall, and method of construction, appear to be sufficient for the separation of the British specimens from Parker's boreal species, which has a thick wall constructed of fine sand with little cement, and is very brittle. The British species, on the other hand, uses very fine mica flakes only in the construction of its test, which, in spite of the thinness of the wall, is capable of sustaining pressure to the extent of distortion without fracture.

The Plymouth specimens are only about half the size of those from Clare Island and from the Moray Firth, where the organism is not uncommon, and are more deeply coloured at the aboral extremity.

AMMODISCUS Reuss.

74. *Ammodiscus incertus* (d'Orbigny).

Operculina incerta d'Orbigny, 1839, FC, p. 49, pl. vi, figs. 16, 17.

Ammodiscus incertus Cushman, 1910, etc., FNP, 1910, p. 73, fig. 95.

Station 2.

Small and very rare.

75. *Ammodiscus gordialis* (Jones & Parker).

Trochammina squamata gordialis Jones & Parker, 1860, RFM, p. 304.

Ammodiscus gordialis Brady, 1884, p. 333, pl. xxxviii, figs. 7-9.

Stations 1, 2, 5.

Rare. Most frequent and the best specimens at Station 2.

76. *Ammodiscus charoides* (Jones & Parker).

Trochammina squamata charoides Jones & Parker, 1860, RFM, p. 304.

Trochammina charoides Carpenter, Parker & Jones, 1862, IF, p. 141, pl. xi, fig. 3.

Ammodiscus charoides Brady, 1884, FC, p. 334, pl. xxxviii, figs. 10-16.

Station 2.

Two abnormal individuals.

TROCHAMMINA Parker & Jones.

77. *Trochammina squamata* Jones & Parker.

Trochammina squamata Jones & Parker, 1860, RFM, p. 304, and Table.

Trochammina squamata Carpenter, Parker & Jones, 1862, IF, p. 141, pl. xi, fig. 1.

Trochammina squamata Heron-Allen & Earland, 1915, FSC, p. 41, pl. vi, figs. 4-6.

Stations 2, 4, 6, 7.

Never common; the best at Station 2, where a double (? budded) individual was found, similar to those figured in FSC (*ut supra*).

78. *Trochammina rotaliformis* Wright.

Trochammina inflata (Montagu), var. Balkwill & Wright, 1885, DIS, p. 331, pl. xiii, figs. 11, 12.

Trochammina rotaliformis Heron-Allen & Earland, 1913, CI, p. 52, pl. iii, figs. 11-13.

Stations 2, 4.

Very fine specimens frequent at Station 2, rare at Station 4.

79. *Trochammina ochracea* (Williamson).

Rotalina ochracea Williamson, 1858, RFGB, p. 55, pl. iv, fig. 112; pl. v, fig. 113.

Trochammina ochracea Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 619, pl. xlvi, figs. 27, 28.

Stations 1, 2, 4-7.

Small, but frequent and typical. Two specimens with marginal chitinous extension such as we figured from Kerimba Archipelago, E. Africa (*ut supra*), but less prominently developed, were found at Station 2.

80. *Trochammina plicata* (Terquem).

Patellina plicata Terquem, 1875, etc., APD, 1876 (fasc. ii), p. 72, pl. viii, fig. 9.

Trochammina plicata Balkwill & Millett, 1884, FG, p. 26, pl. i, fig. 8.

Stations 2, 4.

Remarkably fine specimens are not uncommon at Station 2.

81. *Trochammina inflata* (Montagu).

Nautilus inflatus Montagu, 1808, TB, Suppl., p. 81, pl. xviii, fig. 3.

Rotalina inflata Williamson, 1858, RFGB, p. 51, figs. 93, 94.

Trochammina inflata Brady, 1884, FC, p. 338, pl. xli, fig. 4.

Station 2.

A single specimen only. The rarity of this common British species is very curious.

82. *Trochammina inflata* var. *macrescens* Brady.

Trochammina inflata var. *macrescens* Brady, 1870, FTR, p. 290, pl. xi, fig. 5.

Trochammina inflata var. *macrescens* Heron-Allen & Earland, 1913, CI, p. 52.

Station 7.

A single specimen.

Family—Textulariidae.

Sub-Family—Textulariinae.

TEXTULARIA Defrance.

83. *Textularia sagittula* Defrance.

- *Textularia sagittula* Defrance, 1824, Dict. Sci. Nat., vol. xxxii, p. 177 ; vol. liii, p. 344 ; Atlas Conch., pl. xiii, fig. 5.

Textularia sagittula Blainville, 1825–27, Manuel Malac. et Conch., p. 370, pl. v, fig. 6 (error for 5).

Textularia sagittula Brady, 1884, FC, p. 361, pl. xlii, figs. 17, 18.

Spiroplecta sagittula Wright, 1891, SWI, p. 471.

Spiroplecta sagittula Wright, 1902, FRI, p. 211, pl. iii, figs. C, D, E.

Spiroplecta wrightii Silvestri, 1903, S, pp. 1–5, woodcuts.

Spiroplecta wrightii Heron-Allen & Earland, 1913, CI, p. 56 ; 1916, FSC, p. 42, pl. vi, figs. 7–10.

Spiroplecta wrightii Lacroix, 1929, Bull. Inst. Ocean. Monaco, No. 532,

“ *Textularia sagittula* ou *Spiroplecta wrightii* ? ” pp. 12, figs. 1–10.

Stations 1, 2, 4.

The relationship which the acutely-pointed specimens of *Textularia sagittula* bear to the rounded and spiroplectine individuals separated by A. Silvestri under the name *Spiroplecta wrightii* has been a subject of controversy for years. We dealt at some length with the arguments in our Clare Island paper (*ut supra*), in which we separated the forms. Further consideration of the subject and the examination of a great number of specimens from various localities have led us to reconsider the position, and to agree with the conclusion arrived at by Dr. E. Lacroix in his recently-published paper (*ut supra*), viz., that *Spiroplecta wrightii* Silvestri is the megalospheric condition of *Textularia sagittula* Defrance and must therefore be regarded as a synonym of that species.

Lacroix, in his interesting and able paper, records the results obtained from the examination of a large series of specimens. He shows that both *T. sagittula* and *S. wrightii* are normally spiroplectine in their initial stages, differing only in the sizes of the proloculum.

This had already been observed by J. Wright in 1902 (*ut supra*), and was

his reason for transferring DeFrance's species to the genus *Spiroplecta*. But we know now : (1) A spiroplectine mode of growth is normal in many species of *Textularia* in the initial stages ; (2) *Spiroplecta* Ehbg. 1844 must be abandoned as a generic name, under the Rules of Priority, in favour of *Heterohelix* Ehbg. ; (3) *Heterohelix* is perforate, and therefore inapplicable to DeFrance's species, which is arenaceous.

Lacroix also demonstrates, by a series of drawings, how the outer chambers of the spiroplectine coil, which is very small and delicate in the microspheric form, are frequently worn away, leaving a shell which presents the delusive appearance of a regular biserial with a terminal proloculum, which is, in fact, the proloculum of the original spiroplectine coil. Lacroix contends that a truly textularian specimen of *T. sagittula* does not exist, and can never have existed, except in some abnormal cases which he describes and figures, in which a suppression of some of the spiroplectine chambers gives a pseudo-textularian appearance to the initial portion of the test.

From our own observations we can confirm most of Lacroix's arguments. It is impossible to prove the negation that a microspheric specimen of *T. sagittula* without initial spiroplectine chambers does not exist, but we must admit that we have not met with such a specimen in the large series which we have examined. We have observed that the microspheric individuals differ greatly with their environment, those from muddy deposits generally having the spiroplectine coil perfect, whereas in those from coarser material the apex is frequently so worn that the outer chambers of the coil are missing, and the shell looks regularly textularian. But in every such case a critical examination shows traces of the spiroplectine coil.

For the purpose of this paper we have examined several thousand, and have mounted several hundred specimens, both as opaque objects and for examination by transmitted light. As is usually the case, the proportion of microspheric to megalospheric individuals, both in the young and in the adult stages, is very small ; in the young stage we found but one or two specimens at the most, and in the adult stage among thousands we have found only five or six.

The species was extraordinarily common at Station 2, which supplied us with most of our specimens, the " control " observations being made from a dredging in the North Sea (103 metres), in 60° 35' N. 1° 52½' W., and from Mounts Bay (35-40 fms. FSC, Station 1).

Specimens were also found of the strongly lobulated type.

NOTE.—It must be said at once that the difficulty of separating *T. agglutinans*, *gramen* and *conica* in these gatherings is extreme, the first running imperceptibly into the second, and the second into the third.

84. *Textularia agglutinans* d'Orbigny.

Textularia agglutinans d'Orbigny, 1839, FC, p. 144, pl. i, figs. 17, 18, 32-4.

Textularia agglutinans Parker & Jones, 1865, NAAF, p. 369, pl. xv, fig. 21.

Textularia agglutinans Brady, 1884, FC, p. 363, pl. xliii, figs. 1-3.

Station 2.

None of the specimens are really typical, but intermediates between *T. agglutinans* and *T. gramen* are frequent.

85. *Textularia gramen* d'Orbigny.

Textularia gramen d'Orbigny, 1846, FFV, p. 248, pl. xv, figs. 4-6.

Textularia gramen Brady, 1884, FC, p. 365, pl. xliii, figs. 9-10.

Stations 1-5.

Typical and abundant at Stations 2 and 5, less common at the other stations.

86. *Textularia conica* d'Orbigny.

Textularia conica d'Orbigny, 1839, FC, p. 143, pl. i, figs. 19, 20.

Textularia conica Brady, 1884, FC, p. 365, pl. xliii, figs. 13, 14 ; pl. cxiii, fig. 1.

Stations 1-8.

Universally distributed, and presenting every stage of development until it merges into *T. gramen*.

87. *Textularia trochus* d'Orbigny.

Textularia trochus d'Orbigny, 1840, CBP, p. 45, pl. iv, figs. 25-6.

Textularia trochus Brady, 1884, p. 366, pl. xliii, figs. 15-19 (only).

Station 2.

A single specimen recorded with some doubt in view of the occurrence in quantity of *Gaudryina rudis*, from which the Plymouth specimens only differ by the comparative smoothness of the test and the biserial arrangement of the early chambers seen in broken specimens.

88. *Textularia turris* d'Orbigny.

Textularia turris d'Orbigny, 1840, CBP, p. 46, pl. iv, figs. 27, 28.

Textularia turris Brady, 1884, FC, p. 366, pl. xliv, figs. 4, 5.

Station 4.

One specimen only, which from its general appearance we are inclined to regard as a fossil, though its provenance is obscure.

VERNEUILINA d'Orbigny.

89. *Verneuilina polystropha* (Reuss).

Bulimina polystropha Reuss, 1845-6, VBK, pl. ii, p. 109; pl. xxiv, fig. 58.

Verneuilina polystropha Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 631; 1920, VP (*passim*), pl. xvi-xviii.

Stations 1-8.

The best specimens at Stations 1, 5, 8. At Station 1 several abnormal specimens, such as we figured in 1920, were found. There is the usual range of form due to size of the primordial chamber.

90. *Verneuilina pusilla* Goës.

Verneuilina pygmaea Goës, 1894, ASF, p. 33, pl. vii, figs. 262-3.

Verneuilina pusilla Goës, 1896, DOA, p. 39, pl. v, figs. 6-8.

Verneuilina polystropha Heron-Allen & Earland, 1913, CI, p. 55, pl. iv, figs. 3-5.

Verneuilina pusilla Heron-Allen & Earland, 1920, VP (*passim*), pl. xvi, fig. 11; pl. xvii, figs. 12, 13.

Station 4.

Three specimens of this pretty little species were found.

GAUDRYINA d'Orbigny.

91. *Gaudryina filiformis* Berthelin.

Gaudryina filiformis Berthelin, 1880, EAM, p. 25, pl. xxiv, fig. 8.

Gaudryina filiformis Heron-Allen & Earland, 1913, CI, p. 57, pl. iv, figs. 7-9; 1914, etc., FKA, 1915, p. 634; 1915, FWS, p. 232.

Stations 1, 2, 4, 6, 7.

We see no reason to modify the views we expressed in 1915 (FWS, *ut supra*) concerning this species. British specimens are much closer to Berthelin's original figure than to Brady's type. Brady's specimens were from tropical seas, and show certain differences which may justify Cushman in separating them from Berthelin's type under the name *G. pseudofiliformis* (Cushman, 1910, etc., FNP, pt. 2, 1911, p. 70, fig. 111).

92. *Gaudryina rudis* Wright.

Gaudryina rudis Wright, 1900, DBC, p. 53, pl. ii, fig. 1.

Gaudryina rudis Heron-Allen & Earland, 1913, CI, p. 58, pl. iii, 14-17.

Station 2.

Extremely common in the coarse material from Station 2, and almost indistinguishable from *T. trochus*, excepting as described under that heading.

VALVULINA d'Orbigny.

93. *Valvulina fusca* (Williamson).

Rotalina fusca Williamson, 1858, RFGB, p. 55, pl. v, figs. 114, 115.

Valvulina fusca Cushman, 1910, etc., FNP, 1911, p. 59, figs. 94, 95.

Station 2.

A single large specimen.

CLAVULINA d'Orbigny.

94. *Clavulina obscura* Chaster.

Verneuilina polystropha (Reuss), "dimorphous form," Wright, 1886, BLP, p. 320, pl. xxvi, fig. 2.

Clavulina obscura Chaster, 1892, FS, p. 58, pl. i, fig. 4.

Clavulina obscura Heron-Allen & Earland, 1913, CI, p. 59, pl. iv, fig. 6.

Stations 1, 2, 4, 6, 7.

Large and frequent at Station 1, smaller and rare at the other stations.

Sub-Family—Bulimininæ.

BULIMINA d'Orbigny.

NOTE.—The Bulimininæ are not strongly represented in the Plymouth gatherings. As a general rule, they favour deeper and muddier water, and most of the species at Plymouth are below average size and weakly developed, though specimens are often numerous. Intermediate varieties are plentiful.

95. *Bulimina pupoides* d'Orbigny.

Bulimina pupoides d'Orbigny, 1846, FFV, p. 185, pl. xi, figs. 11, 12.

Bulimina pupoides Williamson, 1858, RFGB, p. 62, figs. 124, 125.

Stations 2, 4, 5-7. Rare.

96. *Bulimina affinis* d'Orbigny.

Bulimina affinis d'Orbigny, 1839, FC, p. 105, pl. ii, figs. 25, 26.

Bulimina affinis Brady, 1884, FC, p. 400, pl. L, fig. 14.

Station 4.

A single typical specimen.

97. ***Bulimina ovata*** d'Orbigny.

Bulimina ovata d'Orbigny, 1846, FFV, p. 185, pl. xi, figs. 13, 14.

Bulimina ovata Brady, 1884, FC, p. 400, pl. L, fig. 13.

Station 4.

A single specimen.

98. ***Bulimina fusiformis*** Williamson.

Bulimina pupoides, var. *fusiformis* Williamson, 1858, RFGB, p. 63, pl. v, figs. 129, 130.

Bulimina fusiformis Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 638.

Stations 1-6.

Common at Station 2, rare at the others, but fine and typical specimens.

99. ***Bulimina elegans*** d'Orbigny.

Bulimina elegans d'Orbigny, 1826, TMC, p. 270, No. 10, Modèle No. 9.

Bulimina elegans Brady, 1884, p. 398, pl. L, figs. 1-4.

Stations 1, 2, 4-8.

Only a very few really typical specimens, the majority verging towards the *pupoides* type, in which form it is common everywhere.

100. ***Bulimina elongata*** d'Orbigny.

Bulimina elongata d'Orbigny, 1826, TMC, p. 269, No. 9.

Bulimina elongata Brady, 1884, FC, p. 401, pl. li, figs. 1, 2 (?).

Stations 1, 2, 4-6, 8.

A few good specimens and many intermediate between *B. elegans* and *B. marginata*.

101. ***Bulimina marginata*** d'Orbigny.

Bulimina marginata d'Orbigny, 1826, TMC, p. 269, No. 4, pl. xii, figs. 10-12.

Bulimina marginata Brady, 1884, FC, p. 405, pl. li, figs. 3-5.

Stations 1, 2, 4-8.

The best specimens at Stations 4, 5, 8.

102. ***Bulimina aculeata*** d'Orbigny.

Bulimina aculeata d'Orbigny, 1826, TMC, p. 269, No. 7.

Bulimina pupoides var. *spinulosa* Williamson, 1858, RFGB, p. 63, fig. 128.

Station 4.

One feeble specimen only of true *B. aculeata*, but a good many of the weak *B. marginata* type with a terminal spine, with which we were familiar in 1915 (cf. FSC).

103. *Bulimina squammigera* d'Orbigny.

Bulimina squammigera d'Orbigny, 1839, FIC, p. 137, pl. i, figs. 22-4.

Bulimina squammigera Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 642, pl. xlviii, figs. 31-5.

Stations 1, 2, 6, 7.

Very few specimens, best at Stations 6, 7.

104. *Bulimina elegantissima* d'Orbigny.

Bulimina elegantissima d'Orbigny, 1839, FAM, p. 51, pl. vii, figs. 13, 14.

Bulimina elegantissima Williamson, 1858, RFGB, p. 64, figs. 134-5.

Stations 1, 4, 6.

Frequent and good at Station 4, otherwise rare.

105. *Bulimina minutissima* Wright.

Bulimina minutissima Wright, 1902, GFL, p. 190, pl. xiii, figs. 9-12.

Bulimina minutissima Heron-Allen & Earland, 1913, CI, p. 62, pl. iv, figs. 11, 12.

Station 2.

Very rare. Four specimens were found. On account of its size it is easily overlooked, and is probably commoner than the paucity of records would suggest.

VIRGULINA d'Orbigny.

106. *Virgulina schreibersiana* Czjzek.

Virgulina schreibersiana Czjzek, 1848, FWB, p. 147, pl. xiii, figs. 18-21.

Virgulina pupoides var. *compressa* Williamson, 1858, RFGB, p. 63, fig. 131.

Stations 1, 2, 4, 5.

Rare and feeble, never more than one or two specimens found at a station.

107. *Virgulina subsquamosa* Egger.

Virgulina subsquamosa Egger, 1857, MSO, p. 295, pl. viii, figs. 19-21.

Virgulina subsquamosa Cushman, 1910, etc., FNP, 1911, p. 92, fig. 145.

Stations 4, 8.

A few specimens only.

BIFARINA Parker & Jones.

- 107A. **Bifarina porrecta** (Brady) var. **arenacea** Heron-Allen & Earland.

Bifarina porrecta, var. *arenacea* H.-A. & E., 1922, TN, p. 132, pl. iv, figs. 23-6.

At Station 2 a single specimen was found resembling in all respects the specimens from New Zealand referred to above, except in its smaller dimensions. It is only 0.3 mm. in length.

BOLIVINA d'Orbigny.

108. **Bolivina laevigata** (Williamson).

Textularia variabilis var. *laevigata* Williamson, 1858, RFGB, p. 77, pl. vi, fig. 168.

Bolivina laevigata Brady, 1887, SBRF, p. 900.

Bolivina laevigata Heron-Allen & Earland, 1908, etc., SB, 1911, p. 316, pl. x, figs. 8, 9.

Stations 1, 2, 4, 6, 7.

Few specimens, but well developed. This easily-recognised species seems to be subject to little variation except in size.

109. **Bolivina textilarioides** Reuss.

Bolivina textilarioides Reuss, 1862, NHG, p. 81, pl. x, fig. 1.

Bolivina textilarioides Brady, 1884, FC, p. 419, pl. lii, fig. 23 (only).

Stations 1, 2, 5.

Rare at all stations.

110. **Bolivina nobilis** Hantken.

Bolivina nobilis Hantken, 1875, CSS, p. 65, pl. xv, fig. 4.

Bolivina nobilis Cushman, 1910, etc., FNP, 1911, p. 39, fig. 64.

Stations 2, 4, 6, 7.

An occasional specimen very feebly striate. The best at Station 6.

111. **Bolivina punctata** d'Orbigny.

Bolivina punctata d'Orbigny, 1839, FAM, p. 63, pl. viii, figs. 10-12.

Bolivina punctata Brady, 1884, FC, p. 417, pl. lii, figs. 18-19.

Stations 1, 2, 4-8.

Rare excepting at Station 4, where it was common. Many of the specimens not typical.

112. *Bolivina dilatata* Reuss.

Bolivina dilatata Reuss, 1849-50, FOT, p. 381, pl. iii (xlvi), fig. 15.

Bolivina dilatata Brady, 1884, FC, p. 418, pl. lii, figs. 20, 21.

Stations 1-7.

Good specimens occur at most stations, usually in two forms, long-narrow, and short-broad. At Station 7 one of the long specimens exhibits a twist like *B. tortuosa* Brady.

113. *Bolivina difformis* (Williamson).

Textularia variabilis, var. *difformis* Williamson, 1858, RFGB, p. 77, pl. vi, figs. 166, 167.

Bolivina pygmaea Brady, 1884, FC, p. 421, pl. liii, figs. 5, 6.

Stations 2, 4.

Rare but typical.

114. *Bolivina robusta* Brady.

Bolivina robusta Brady, 1879, etc., RRC, 1881, p. 57; 1884, FC, p. 421, pl. liii, figs. 7, 9.

Stations 1, 2, 4, 5.

Rare. Good specimens at Station 4.

115. *Bolivina aenariensis* (Costa).

Brizalina aenariensis Costa, 1853, etc., PRN, 1856, p. 297, pl. xv, figs. 1, 2.

Bolivina aenariensis Cushman, 1910, etc., FNP, 1911, p. 44, fig. 71.

Station 2.

One doubtful specimen. It has not the longitudinal costæ marking the species, and may be an abnormally large *B. dilatata*.

116. *Bolivina beyrichi* Reuss.

Bolivina beyrichi Reuss, 1851, FSUB, p. 83, pl. vi, fig. 51.

Bolivina beyrichi Heron-Allen & Earland, 1916, FWS, p. 239, pl. xli, fig. 15.

Stations 4, 6.

Very rare. The specimens are weak and far from typical. The species has been recorded as British only by us, *ut supra*.

117. *Bolivina variabilis* (Williamson).

Textularia variabilis (typica) Williamson, 1858, RFGB, p. 76, pl. vi, figs. 162, 168 (numbered 161, 162 on the plate).

Bolivina variabilis Cushman, 1918, etc., FAO, pt. 8, 1922, p. 49, pl. iv, fig. 3.

Stations 1, 2, 4-7.

Common and frequent at all the stations, except Station 7, where the individuals were few and weakly developed.

118. *Bolivina inflata* Heron-Allen & Earland.

Bolivina inflata Heron-Allen & Earland, 1913, CI, p. 68, pl. iv, figs. 16-19; 1915, FKA, p. 648; 1916, FSC, p. 43; 1916, FWS, p. 240.

Stations 2, 3, 4, 6, 7.

Very rare, and sometimes weakly developed. As regards this specific name, see our observations in FSC, *ut supra*.

119. *Bolivina pseudo-plicata* nom. nov.

Plate III, figs. 36-40.

Bolivina plicata Brady, 1870, FTR, p. 302, pl. xii, figs. 7a, b (*non* d'Orbigny, 1839, FAM, p. 62, pl. viii, figs. 4-7).

Bolivina plicata Halkyard, 1889, RFJ, p. 65, pl. i, fig. 13.

In adding *Bolivina plicata* d'Orbigny to the British fauna in 1870, Brady was apparently acting without personal acquaintance with d'Orbigny's type. He writes: "d'Orbigny's figures of *B. plicata* are, as usual, somewhat diagrammatic, designed from the theoretical morphology of the shell rather than its actual appearance."

This is far from the case. D'Orbigny's figure is an excellent picture of a species described as from deep water off Valparaiso, Chile. It is still to be found there very abundantly, and is apparently confined to that region. How far to the north and south its range extends we do not know, but we have not met with it in the Falkland area, or in any Pacific islands material. It is characterised by the presence of three or four longitudinal costæ which are straight, the plications being confined to the intercostal spaces.

The British form, which was admirably figured by Brady, has a raised process zigzagging down each parallel series of chambers, becoming broader with the growth of the chambers, and often breaking up into secondary plications. It varies greatly in the strength and shape of the markings, also in size.

It is rather curious that such a common and characteristic British form should have gone unnoticed until Brady made his incorrect attribution of it

to d'Orbigny's species. Since 1870 there have been a great many records of *Bolivina plicata* d'Orb. All existing British records must now be transferred to our new species *B. pseudo-plicata*, probably all European, and most other records also, as the species appears to have quite a wide range in contrast with d'Orbigny's species. There is a very good woodcut illustration of our species on p. 141 of Hofker's work "Die Protozoen" in "Flora en Fauna der Zuider See," Leyden, 1922, where it is incorrectly ascribed to *B. subangularis* Brady, a species confined to the Malay-Pacific area.

Sub-Family—Cassidulininæ.

CASSIDULINA d'Orbigny.

120. *Cassidulina laevigata* d'Orbigny.

Plate III, figs. 44-46.

Cassidulina laevigata d'Orbigny, 1826, TMC, p. 282, No. 1, pl. xv, figs. 4, 5.

Cassidulina laevigata Williamson, 1858, RFGB, p. 68, pl. vi, figs. 141-2.

Stations 2, 7.

At Station 2 a specimen characterised by strongly inflated chambers and sunken sutures occurred. In these points it exactly resembles d'Orbigny's fig. 4 (*ut supra*). His fig. 5, on the other hand, representing the edge-oral view of his type, gives no indication of these features, and is much more in conformity with the accepted view of his species. But for the existence of d'Orbigny's figure, we should have regarded the specimen as a variation of *C. crassa* d'Orb.

Dimensions: width 0.28 mm.; breadth 0.14 mm.; greatest thickness 0.14 mm.

121. *Cassidulina pulchella* d'Orbigny.

Cassidulina pulchella d'Orbigny, 1839, FAM, p. 57, pl. viii, figs. 1-3.

Two very small specimens at Station 6. The species has only been recorded as British by Siddall and Brady in their "Catalogue of British Recent Foraminifera" (Chester, 1879). In Brady's Synopsis (1877, SBRF, p. 900) he doubts the validity of the species as differentiated from *C. laevigata*, but the rounded periphery is quite distinctive.

122. *Cassidulina crassa* d'Orbigny.

Cassidulina crassa d'Orbigny, 1839, FAM, p. 56, pl. vii, figs. 18-20.

Cassidulina crassa Brady, 1884, FC, p. 429, pl. liv, figs. 4, 5.

Stations 2, 4-7.

Not uncommon at Station 4, very few elsewhere. All small.

123. *Cassidulina subglobosa* Brady.

Cassidulina subglobosa Brady, 1879, etc., RRC, 1881, p. 60; 1884, FC, p. 430, pl. liv, fig. 17.

Cassidulina subglobosa Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 652 (references).

Stations 1, 2, 6, 7.

Very rare, and all very small. Best at Station 2.

124. *Cassidulina nitidula* (Chaster).

Pulvinulina nitidula Chaster, 1892, FS, p. 66, pl. i, fig. 17.

Cassidulina nitidula Heron-Allen & Earland, 1913, CI, p. 70, pl. v, figs. 6-9.

Stations 2, 6.

Three good specimens in all.

DESCRIPTION OF PLATES.

PLATE I. *Cornuspira diffusa* Heron-Allen & Earland.

On the 17th June, 1894, the late J. J. Lister, F.R.S., found, in a gathering at Plymouth, an organism of which he made one of his beautiful water-colour drawings, showing the pseudopodia fully extended, a mass of protoplasm protruding from the aperture, and with yellow globules scattered among the pseudopodia, which he took to be "fat?" He wrote underneath it "Fan-shaped Rhizopod." On the 20th June, 1905, he found and drew another specimen, and his drawing (in various tones of sepia) is here reproduced. He made no manuscript notes upon either specimen, excepting to record the length of the 1905 test as "about 1 mm." This was the organism, an initial portion of which Brady figured as a monstrous specimen of *Cornuspira foliacea* Philippi (Chall. Rep., pl. xi, fig. 7—no reference in the text), and to which, in 1913, when abundant material was available from the North Sea, we gave the specific name as *Cornuspira diffusa* (J. R. Micr. Soc., 1913, pp. 272-6, pl. xii).

PLATE II.

- Fig. 1.—*Biloculina elongata*, var. *quadrata* var. nov. Front view. × 48.
- Fig. 2.—*Biloculina elongata*, var. *quadrata* var. nov. Rear view. × 48.
- Fig. 3.—*Biloculina elongata*, var. *quadrata* var. nov. Edge view. × 48.
- Fig. 4.—*Biloculina elongata*, var. *quadrata* var. nov. Oral view. × 48.
- Fig. 5.—*Miliolina disparilis* d'Orbigny. Front view. × 33.
- Fig. 6.—*Miliolina disparilis* d'Orbigny. Edge view. × 33.
- Fig. 7.—*Miliolina disparilis* d'Orbigny. Oral view. × 33.
- Fig. 8.—*Miliolina dunkerquiana* nom. nov. Front view. × 48.
- Fig. 9.—*Miliolina dunkerquiana* nom. nov. Rear view. × 48.
- Fig. 10.—*Miliolina dunkerquiana* nom. nov. Edge view. × 48.
- Fig. 11.—*Miliolina dunkerquiana* nom. nov. Oral view. × 48.
- Fig. 12.—*Miliolina oblonga*, var. *lata* Terquem. Front view. × 48.
- Fig. 13.—*Miliolina oblonga*, var. *lata* Terquem. Rear view. × 48.
- Fig. 14.—*Miliolina oblonga*, var. *lata* Terquem. Edge view. × 48.
- Fig. 15.—*Miliolina oblonga*, var. *lata* Terquem. Oral view. × 48.
- Fig. 16.—*Miliolina schlumbergeri* nom. nov. } Side views × 110.
- Fig. 17.—*Miliolina schlumbergeri* nom. nov. } at different × 110.
- Fig. 18.—*Miliolina schlumbergeri* nom. nov. } angles. × 110.
- Fig. 19.—*Miliolina schlumbergeri* nom. nov. Oral view. × 110.
- Fig. 20.—*Miliolina badenensis* (d'Orbigny). Front view. × 110.
- Fig. 21.—*Miliolina badenensis* (d'Orbigny). Edge view. × 110.
- Fig. 22.—*Miliolina badenensis* (d'Orbigny). Oral view. × 110.
- Fig. 23.—*Miliolina candeina* (d'Orbigny). Front view. × 110.
- Fig. 24.—*Miliolina candeina* (d'Orbigny). Rear view. × 110.
- Fig. 25.—*Miliolina candeina* (d'Orbigny). Oral view. × 110.

PLATE III.

- Fig. 26.—*Miliolina cliarensis* sp. nov. Front view. $\times 110$.
 Fig. 27.—*Miliolina cliarensis* sp. nov. Rear view. $\times 110$.
 Fig. 28.—*Miliolina cliarensis* sp. nov. Edge view. $\times 110$.
 Fig. 29.—*Miliolina cliarensis* sp. nov. Oral view. $\times 110$.
 Figs. 30, 31.—*Miliolina cliarensis* sp. nov. In optical section mounted in balsam. $\times 110$.
 Fig. 32.—*Iridia diaphana* Heron-Allen and Earland. Inferior side showing protoplasmic body inside chitinous membrane. $\times 33$.
 Fig. 33.—*Iridia diaphana* Heron-Allen and Earland. Superior side. $\times 33$.
 Fig. 34.—*Hippocrepina pusilla* sp. nov. Side view. $\times 110$.
 Fig. 35.—*Hippocrepina pusilla* sp. nov. Oral view. $\times 110$.
 Figs. 36–38.—*Bolivina pseudo-plicata* nom. nov. Side view. $\times 110$.
 Fig. 39.—*Bolivina pseudo-plicata* nom. nov. Edge view. $\times 110$.
 Fig. 40.—*Bolivina pseudo-plicata* nom. nov. Oral view. $\times 110$.
 Fig. 41.—*Lagena crenata* (var.) Parker and Jones. $\times 110$.
 Fig. 42.—*Lagena crenata* (var.) Parker and Jones. Basal view. $\times 110$.
 Fig. 43.—*Orthocerina bicamerata* sp. nov. $\times 150$.
 Fig. 44.—*Cassidulina laevigata* (var.) d'Orbigny. Lateral-oral view. $\times 150$.
 Fig. 45.—*Cassidulina laevigata* (var.) d'Orbigny. Lateral-posterior view. $\times 150$.
 Fig. 46.—*Cassidulina laevigata* (var.) d'Orbigny. Edge view. $\times 150$.

NOTE.—Figs. 41–43 will be described in the second part of this paper.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

A Modification of d'Alzheimer's Method VI for the Neuroglia of the Central Nervous System.—A. HADJIOLOFF ("Sur l'étude de la néuroglie du système nerveux central par une modification de la méthode vi d'Alzheimer," *Compt. rend. Soc. de Biol.*, 1929, **102**, 780-3, 2 text-figs.). The method is as follows:—Fixation in 10 p.c. formol for at least three days, then fixation in strong Flemming for from 13 to 15 days. The tissues are washed in water for from 12 to 48 hours, then embedded in paraffin. Sections are cut of from 2 to 5 μ in thickness and placed on slides. A drop of xylol is placed on each section with a pipette and subsequently removed, and then descending alcohols to water. A saturated alcoholic solution of acid fuchsin is used, and is allowed to act for 5 to 15 minutes at 50° C. After washing with water, two or three drops of a saturated solution of light green are allowed to act for 10 to 20 minutes. Then the sections are washed, passed through alcohols and xylol, and mounted in balsam. The following structures are stained red—nucleoli of the ganglion cells, protoplasmic granules, nuclei of certain neuroglia cells, neuroglia fibres, endothelial nuclei and myelin granules. The following structures stain green—the protoplasm and chromatin of the ganglion cells, the protoplasm and certain nuclei of the neuroglia cells, the nerve cylinders and the connective tissue of the brain.

G. M. F.

Silver as a Staining Reagent.—G. F. LAIDLAW ("Silver Staining of the Skin and of its Tumours," *Am. J. Path.*, 1929, **5**, 239-47, 1 pl.). The conditions necessary for satisfactory silver staining are: (1) suitable fixation; (2) suitable mordanting; (3) the use of silver solutions ten to twenty times stronger than those in vogue. The results differ according to the fixative used. The technique is as follows:—(i) Fix in Bouin's fluid for 3 days or in 10 p.c. neutral formol for 3 days. Old formol-fixed material may be improved by immersion in fresh neutral formol for 3 days. Formol-fixed tissue immersed in Bouin for 3 days will give nearly perfect pictures of Bouin-fixed material. (ii) Embed in paraffin or celloidin, or make frozen sections. (iii) Stick paraffin sections on the slide with Masson's gelatine glue and harden in hot formol fumes: sections so treated seldom float off. Masson's gelatine glue is prepared by dissolving 0.05 gm. gelatine in 20 c.cm. distilled water, warming it over a flame. A row of slides is placed on the warm plate, and a large drop of the gelatine solution is placed on each slide, the paraffin section being floated on to it. As soon as the section spreads, the slide is

drained, the section being held for a moment in the desired place with a brush or needle. When the excess gelatine has drained off, the section is blotted and placed in the oven at 45–50° C. in formol vapour, secured by leaving in the oven an open dish of formol. For silver staining, the slides are left for several hours or preferably over-night in the oven. (iv) After removal of the paraffin, wash Bouin sections in running water for 20 minutes to remove the picric acid: wash formol sections for five minutes. (v) Mordant with the Mallory bleach. Tissue recently fixed in formol (2 to 10 days) often gives the reaction without mordanting, but not constantly. (a) 1 p.c. tincture of iodine, 3 minutes: rinse in tap water; (b) 5 p.c. sodium thiosulphate, 3 minutes: rinse in tap water; (c) 0.25 p.c. potassium permanganate, 3 minutes: rinse in tap water; (d) 5 p.c. oxalic acid, 3 minutes: wash well in running water for 10 minutes. (vi) Distilled water: change 3 times within 5 or 10 minutes to ensure clean slides entering the silver solution. (vii) Rio-Hortega's lithium silver augmented to 10 p.c. Heat the stock solution in the oven to 50° C. and stain in the oven for 5 minutes. (viii) Rinse the slides by pouring distilled water over both sides. (ix) Formol 1 p.c. in tap water—flood the sections frequently for 3 minutes. (x) Rinse both sides of the slide with distilled water. (xi) Yellow gold chloride, 1 in 500 of distilled water in a Coplin jar; immerse the slides at room temperature for 10 minutes. The gold solution may be used many times. (xii) Rinse both sides of the slide with distilled water. (xiii) Oxalic acid 5 p.c., pour on slide and leave for 10 minutes. (xiv) Rinse with distilled water. (xv) Sodium thiosulphate 5 p.c., change as often as it becomes turbid for 10 minutes. (xvi) Wash in running water and counterstain if desired. After Bouin fixation, the cells of the epidermis are stained with the exception of the cells of the basal layer. The nuclei are colourless, only the cytoplasm retaining the stain. In the corium, the collagen fibrils stain reddish purple, while the fibroblasts, mast cells, vessel endothelium and muscle cells are unstained. Lymphocytes, red cells and leucocytes are stained. After formol fixation, the nuclei of the epidermal cells stain, not the cytoplasm. In the corium the nuclei of the vascular endothelia and the smooth muscle cells retain the stain. G. M. F.

Variations in Staining Character of Bacteria.—E. W. STEARN and A. E. STEARN ("The Variation in Staining Character of Bacteria as related to the Reserve Food Material within the Organism," *Stain Technol.*, 1929, 4, 105–9). When *Bacillus cereus* is starved, it tends to lose Gram-positivity at 37° C., though not at the temperature of the ice chest. In the latter case the cells are probably dormant, and are not undergoing any significant change, while in the former case the results are thought to be due to the using up of acidic reserve food materials (nucleins, nucleo-proteins), when the organism grows in the absence of a nutritive environment. This suggestion is preferable to that of Churchman (*J. Exp. Med.*, 1927, 46, 1007), who postulates a Gram-positive cortex and a Gram-negative medulla. G. M. F.

A Modification of Mayer's Hemalum.—J. E. SASS (*Stain Technol.*, 1929, 4, 127–9, 3 text-figs.). The following is the procedure adopted: Dissolve 50 gm. of alum [$Al_2(NH_4)_2 \cdot 4SO_4$] in 1 litre of boiling water. Remove from the hot-plate and add 1 gm. of hæmatoxylin. Add 1 gm. of sodium iodate ($NaIO_3$), cool and filter. The stain should be filtered whenever a "metallic" scum is present. The solution is best when fresh, but its staining properties are retained for at least six months. The slide is transferred from water to the stain, then washed in distilled water, followed by tap water or sodium carbonate 1 in 100, and again in distilled water. An aqueous or alcoholic counterstain may be used. G. M. F.

Staining of Negri Bodies.—J. H. JORDAN and A. H. HEATHER (*Stain Technol.*, 1929, 4, 121-6). Many techniques have been described for the demonstration of Negri bodies. The majority have only proved successful in their author's hands. An investigation was therefore undertaken to study the question of the staining of Negri bodies. A number of interesting facts were discovered, among them that Negri bodies stain moderately well by Alzheimer's method for degeneration bodies, a point which may have some significance in regard to their origin. The technique finally evolved was as follows:—*Fixation.*—(1) Reasonably thin portions of hippocampus are fixed in Zenker's or Dominici's fluid for four or six hours at 37° C. If the hippocampus is to be pared down, it should be remembered that the ends, especially the anterior, contain the majority of the bodies. (2) 70 p.c. alcohol overnight at room temperature. (3) 80 p.c. alcohol for 5 to 6 hours. (4) 90 p.c. alcohol for 4 to 6 hours. (5) Absolute alcohol overnight, usually about 16 hours. (6) Equal parts of ether and absolute alcohol for 8 hours. (7) Celloidin mixture, 16 to 24 hours (celloidin mixture consists of celluloid II, 1 gm., methyl salicylate 25 cc., abs. alcohol 25 cc., ether 25 cc.). (8) Chloroform-paraffin, 2 to 3 hours. (9) Paraffin 1—2 hours. (10) Paraffin 2—1 to 1½ hours. (11) Embed. *Staining.*—(1) Sections are cut 4 to 5 μ ; they are brought to water and covered with Lugol's iodine for 10 minutes. (2) The iodine is decolourised with 2 p.c. sodium thiosulphate, after which the sections are washed thoroughly in water. (3) Cover with a mixture of equal parts of 0.5 p.c. phloxine and 1 p.c. eosin γ (National aniline brands) and leave for 15 minutes. (4) Wash off with water and stain for 2 to 5 minutes in 0.1 p.c. methylene azure β (National aniline brand). (5) Wash off with 96 p.c. alcohol and decolourise in a mixture of 2 parts absolute alcohol and 1 part clove oil. This solution acts very quickly, and care must be taken not to prolong this stage: $\frac{1}{2}$ to 1 minute is usually sufficient. (6) The section is rapidly dehydrated, cleared and mounted in Yucatan elemi. As an alternative procedure, Goodpasture's staining method is used, but is preceded by mordanting in copper acetate for 1 hour. Zenker's fixative is the best for this method.

G. M. F.

A Method of Contact Staining.—J. WOLF ("Sur la nature de la coloration histologique et sur la méthode de contact," *Bull. d'histol appl.*, 1929, 6, 259-67). Celloidin sections, as, for example, of the elastic cartilage of a bovine ear, are laid between thin sheets of celloidin stained in Böhmer's, Delafield's or Ehrlich's hæmatoxylin and of 15-100 μ thickness. Excess of water is removed by filter paper, and the whole is mounted in Canada balsam without dehydration. The slides are kept for about 24 hours at a temperature of 45° C., after which the balsam is dissolved by xylol. The slides are then passed through the alcohols and water, and differentiated in dilute HCl, or better in iron alum. After dehydration the sections are mounted in the usual manner. The celloidin sheets placed between the sections may require from 15 minutes to 24 hours' staining, depending on their thickness, quality, and the quantity of the hæmatoxylin. By this method there are stained a deep black, elastin, the organic substratum of the calcified substance, fibres and muscle cells, while the background is unstained. Even the albuminoid material of the cartilage, which is generally difficult to stain, is deeply coloured.

G. M. F.

Differential Staining of Brain Tissue.—P. A. STEGALL ("A Method of Differential Staining of the Human Brain," *Anat. Rec.*, 1929, 42, 399). This technique is intended for staining sections of the whole human brain:—Solution I.—Add enough ammonia to one half pound of methylene blue to make a mixture the

consistency of soft putty. To this add three quarts of cedar oil and boil the mixture for ten minutes, stirring vigorously. Cool for four hours and strain through a cloth. Solution II.—Dissolve 40 gm. of mercurochrome—220 soluble in one quart of water containing 100 g. of soap. The proper time for staining in solution I is determined by immersing four slides in the solution and removing one every 5 minutes until the white matter is stained the correct depth. The oil in this bath removes the paraffin. Allow the slide to drain. Place a soft piece of cotton cloth over the section and blot gently. Immerse the slide in strong soap solution for 30 seconds, wash in water and stain in the red dye until the grey matter is the desired colour. Allow the section to dry for not longer than 10 minutes. Put a teaspoonful of cedar oil at the end of the slide and spread it over the section with a piece of fenestra, using the fenestra as a cover. Trim off the edges with a razor blade, smooth the surface with a squeegee roller, wipe off the excess oil and put tape round the edges of the slide. G. M. F.

Practical Hints on Azur II-Eosin Staining of Tissue Sections.—B. UGRUMOW ("Praktische Winke zur Azur II-Eosinfärbung an Schnittpräparaten," *Ztschr. Wis. Mikr.*, 1928, 45, 191-2). Azure II-Eosin made up according to Nocht Maximow is preferable to the May-Grünwald-Giemsa or Panchrome stain. Tissue is fixed in Zenker-formol and embedded in celloidin paraffin. Azure II 1 in 1,000 (Holborn) and eosin BA extra Höchst 1 in 1,000 at pH 6.3-6.6 are used, mixing 1.5 cc. of the eosin solution with 1 cc. of the azure solution and adding 10 cc. of water. Stain 10 to 12 hours, changing a few times. Differentiate with acetone, then xylol and Canada balsam. Neutral Canada balsam should not be used, because sections will fade in it after 2 to 3 weeks, while otherwise they keep for about a year. Neutral granules should be reddish violet, eosinophils bright red, cytoplasm of plasma cells dark blue, premyelocytes greyish-blue with a few carmin red granules. G. M. F.

Anisol in Place of Cedar Oil for Immersion Oil.—H. LENTZE ("Anisol statt Zedernöl als Immersionsmittel nach Becher," *Ztschr. Wis. Mikr.*, 1928, 45, 200-2). Anisol, which is a phenyl-methyl-ether ($C_6H_5 \cdot O \cdot CH_3$), is regarded as superior to cedar oil as an immersion oil, as it does not become sticky or thick after exposure to air. Its refractive index is 1.5103, while that of thick cedar oil is 1.51 or 1.52, and that of thin cedar oil 1.504. It is a thin clear liquid, which may darken, though this change does not influence its refractive qualities. It does not damage lenses or metal plates, while blood films stained by the Giemsa method have not faded after soaking in it for a day. The thinness of anisol is, however, a disadvantage, as it tends to run down when used on a floating stage. G. M. F.

Petragnani's Method for Bacterial Flagella and its Application to the Staining of Animal Tissues.—A. FRANCONI ("Il metodo Petragani per le ciglia batteriche e le sue applicazioni alla colorazione de tessuti animali," *Bull. d'histol. appliq.*, 1929, 6, 306-14). The first step is the mordanting of the bacterial films in a mixture of the following solutions. Solution A.—Tannic acid (pure) 7 g., ferric chloride 35 g., ethyl alcohol 35 cc., distilled water 15 cc. Solution B.—Pot. alum (crystals) 3 g., zinc acetate (crystals) 0.5 g., acetic acid (glacial) 3 drops, distilled water 10 cc. After washing, the preparation is stained in the cold in Ziehl's carbol fuchsin, gentian violet, or in a saturated alcoholic solution of crystal violet in aniline water. The same technique may be used on paraffin sections of various animal tissues. G. M. F.

A Nuclear and Differential Stain Combined.—G. J. BRILMYER (*Science*, 1928, **68**, 114). The method consists in combining the use of Delafield's hæmatoxylin with Mallory's connective tissue stain. The staining follows any form of fixation. G. M. F.

A Modification of Flemming's Safranin, Gentian Violet, Orange G Method.—J. O. FOLEY ("Studies in Stain Technique. I. Flemming's Safranin, Gentian Violet, Orange G Method, with a Suggested Modification," *Anat. Rec.*, 1929, **43**, 171–85). (i) The sections are mordanted in 0.5 p.c. aqueous solution of osmic acid for 30 minutes to 1 hour. This is omitted for material which has been fixed in fluids containing osmic acid. (ii) Wash in water and stain for from 1 to 3 hours or more in 1 p.c. aqueous safranin. (iii) Rinse in water and differentiate in a 0.025 N solution of hydrochloric acid, allowing the acidulated water to remain on the slide until the outline of the nuclei is definite and chromatin granules are discerned. Too much stain must not be removed at this point: rinse in water. (iv) Stain in a 0.27 to 0.30 p.c. solution of crystal violet in 7 p.c. alcohol for about 20 minutes. (v) Differentiate as in (iii). (vi) Rinse in water and place in Gram's solution for 1 to 3 minutes or until the slides are a deep black. (vii) Wash off excess of iodine and immerse in a 1 p.c. solution of bichloride of mercury for 1 to 3 minutes, or until the sections are a bright blue. (viii) Wash in water and blot off the excess, not letting the sections dry completely. (ix) Immerse in 95 p.c. alcohol for 4 to 6 seconds and transfer to carbol-xylol (25 parts of phenol to 75 parts of xylol), while the xylol is still coming out in clouds. (x) Leave in carbol-xylol from 15 seconds to several minutes or until proper differentiation—that is, when structures such as heads of spermatozoa, metaphase, anaphase and telophase chromosomes and basophilic nucleoli are definitely red and the spireme of prophase is a deep blue. (xi) Wash in xylol and stain in 1 p.c. solution of orange G in clove oil for a few seconds to 1 minute. (xii) Wash in pure clove oil and xylol, mount in balsam. G. M. F.

The Demonstration of the Golgi Apparatus in Free-Living Protozoa.—R. P. HALL ("Modifications of Technique for Demonstration of Golgi Apparatus in Free-Living Protozoa," *Trans. Am. Micr. Soc.*, 1929, **68**, 443–4). The Golgi apparatus may be demonstrated by the following method: Vital dyes, such as neutral red and brilliant cresyl blue, are made up in stock solutions of 1 p.c. in absolute alcohol, and these solutions are diluted with the same solvent until concentrations satisfactory for the organisms to be examined are obtained. In general, flagellates and amœbæ are less sensitive to the dyes used than ciliates. A thin film of the dye is spread over clean slides, and these are then allowed to dry. In order to secure even filming, it is often necessary to warm the slide over a flame for an instant before adding the dye. A drop of culture material is placed on the filmed slide, and a cover-slip sealed in place with melted vaseline. In such preparations amœbæ and various flagellates have lived for 24 hours to several days. G. M. F.

A Technique for Tissue Cultures in Hanging Drops.—A. CARREL ("La technique de la culture des tissus en goutte pendante," *Compt. rend. Soc. de Biol.*, 1929, **102**, 742–4). The difficulty in cultivating tissues in hanging drops is that the pH of the culture medium varies, being too high at the beginning and too low at the end of the experiment. In order to avoid this difficulty, the following technique is employed. Four drops of culture medium are placed on a large quartz slide in such a way that each drop contains a portion of tissue. A metal ring of an internal diameter of 5 cm. and a total height of 1 cm. is then obtained. This

ring has on each face a deep groove, 0.25 cm. in depth, in which the quartz slides are dropped. There is thus obtained a chamber with a thickness of 0.5 cm. The slides are fixed to the ring by means of paraffin. The ring is furnished with two small conical openings opposite each other, into one of which there is inserted a metal cannula fixed to rubber tubing containing a little cotton-wool. On the centre of the disc which forms the floor of the chamber there is placed a drop of medium containing neutral red. Expired air which is saturated with water vapour, and contains 5 p.c. of CO_2 , is blown into the chamber until the desired pH is obtained. Then the cannula is removed and the two orifices are covered with adhesive plaster and paraffin. If the pH of the medium becomes too acid or too alkaline, the orifices can be reopened, and either atmospheric or expired air can be blown into the chamber.

G. M. F.

A Simple Apparatus for Photomicrography with Incident Light.—

H. RUGE ("Ein einfaches Hilfsmittel zur mikrophoto-graphischen Aufnahme von kleineren Gegenständen bei schwacher Vergrößerung und auffallenden Licht (Doppelspiegel nach Plett)," *Klin. Wchnschr.*, 1929, 8, 454–5, 7 text-figs.). The principle of this apparatus, which can be fixed to the stage of any microscope, is simply that of double mirrors to produce equal top lighting of the object. The mirrors are so arranged as to be capable of rotation on their axes through 0° to 180° , of horizontal angular displacement through 0° to 90° , and of a lateral separation amounting to about 10 mm. For ordinary observation daylight or a microscope lamp suffices, and for photomicrography two light sources at right angles to each other are necessary.

G. M. F.

Cytology.

X-Radiation and the Spermatogenesis of *Lepisma domestica*.—R. N.

MUKERJI ("Effect of X-Radiation on the Spermatogenesis of *Lepisma domestica*," *Proc. Roy. Soc., B.*, 1929, 105, 429–45, 3 pls.). As a result of X-radiation of the male germ cells of *Lepisma*, the Golgi bodies are the cell elements which first show cytological changes. The archoplasm and its lipoid cortex undergo certain physical changes, as shown by their staining behaviour and swollen appearance. Fusion of the Golgi rodlets, as well as of the archoplasm, takes place in various ways. The spermatocytes may at times assume the form of a "giant sperm" with a tail, post-nuclear body, and an acrosome. The mitochondrial granules in the spermatocytes become faintly stainable, while those in the spermatids react in a number of ways. The nuclei of the spermatids lose their ability to stain properly. The nurse cells seem to be very resistant to X-rays, as are the mature sperms.

G. M. F.

X-Radiation and the Spermatogenesis of *Abraxas*.—J. B. GATENBY,

R. N. MUKERJI, and S. B. WIGDER ("The Effect of X-Radiation on the Spermatogenesis of *Abraxas grossulariata*," *Proc. Roy. Soc., B.*, 1929, 105, 446–68, 4 pls., 4 text-figs.). The effect of radiation on the testis of *Abraxas* is to kill most of the spermatocytes in the growth stage within 5 hours after radiation. Spermatogonia and spermatids are not so radio-sensitive. Mitotic figures persist to an unexpected degree, and there is no evidence to show that the mitotic prophase is exceptionally radio-sensitive. The mitochondria appear to be more sensitive than the nucleus, which frequently stains well in a cell with damaged cytoplasmic inclusions. In many spermatocytes the Golgi bodies proceed to form abortive acroblasts, which are ultimately absorbed, usually before the cell passes into division, if this happens. No clogged chromosomes were seen, though some anaphase or telophase stages showed signs of abnormal coalescence of chromosomes and of lagging.

G. M. F.

Filterable Viruses and Rickettsia Diseases.—E. B. MCKINLEY (*Philippine J. Sc.*, 1929, **30**, nos. 1–4, 1–416, 70 pls., 7 text-figs.). This monograph forms a most useful compendium of our present knowledge in regard to the filterable viruses. At the present time there are over sixty diseases affecting man, animals, plants, fowls, fishes and insects, which are due to ultramicroscopic viruses, and this number is being constantly increased. The great interest of these viruses, apart altogether from their rôle in pathogenic diseases, lies in the new light which their study is likely to throw on the origins of life. This question and the nature of the ultramicroscopic viruses is discussed in an introductory chapter. In the next eight chapters the various virus diseases afflicting man and animals are reviewed. Rickettsia diseases are given a separate chapter, after which the virus diseases of birds, insects, fish and plants receive attention. The bacteriophage is perhaps somewhat scantily treated, but other more comprehensive treatises exist on this highly controversial problem. There is a short but useful chapter on the question of filterable forms of bacteria, yeasts, spirochaetes and protozoa, and finally a comprehensive survey of the intracellular inclusions which are characteristic of very many virus infections. While many important problems in connection with the filterable viruses receive little or no attention, the salient facts of this rapidly-extending subject are ably discussed.

G. M. F.

Infectious Myxomatosis of Rabbits.—G. M. FINDLAY ("Notes on Infectious Myxomatosis of Rabbits," *Brit. J. Exp. Path.*, 1929, **10**, 214–19, 6 text-figs.). The clinical symptoms and pathological changes of this virus disease of rabbits are described. The disease is characterised by swellings at the root of the ears and eyes, in the tissues of the scrotum, prepuce and around the mouth and anus, associated with a muco-purulent discharge from the nose and conjunctivæ. Histologically the chief feature of the nodular swellings is the enormous dilatation of the connective tissue spaces, which are filled with a mucinous deposit. This mucinous degeneration involves the connective tissues both of the cutis vera and subcutaneous tissues, scattered throughout which are connective-tissue cells, many of them enormously hypertrophied. There is, however, no apparent increase in the number of the connective tissue cells, in the interior of which minute granules were found. No changes were noted in the epidermal cells, such as those recorded by Rivers (*Proc. Soc. Exp. Biol. & Med.*, 1926, **24**, 435).

G. M. F.

The "Rickettsia" of *Periplaneta americana*.—R. W. GLASER ("On the Isolation, Cultivation and Classification of the So-called Intracellular 'Symbiont' or 'Rickettsia' of *Periplaneta americana*," *J. Exp. Med.*, 1930, **51**, 59–82, 1 pl.). In *Periplaneta americana*, the large American cockroach, cells scattered throughout the fatty tissue contain micro-organisms in their cytoplasm. Evidence is presented to show that the intracellular forms are not rickettsia, but are in reality diphtheroid bacteria, for which the name *Corynebacterium periplanetæ* var. *americana* nov. spec. is proposed.

G. M. F.

Survival of Vaccine Virus.—R. S. MUCKENFUSS and T. M. RIVERS ("Survival of Vaccine Virus Separated from Living Cells by Collodion Membranes," *J. Exp. Med.*, 1930, **51**, 149–60). Vaccine virus, suspended in a mixture of serum and Tyrode's solution, and separated by collodion membranes from a suspension of living kidney cells in serum and Tyrode's solution, remained active at 37° C. for a longer period of time than did vaccine virus incubated only in a mixture of serum and Tyrode solution.

G. M. F.

The Effect of Antigens on the Growth of Reticulo-endothelial Cells "in vitro."—Y. TAKANO ("On the Functions of the Reticulo-endothelium in Tissue-cultures," *Nagoya J. Med. Sc.*, 1928, 3, 3-6). Reticulo-endothelial cells from the spleen of the embryo chick, cultivated in a medium containing 5 p.c. of horse serum, were subsequently enabled to grow in sub-cultures containing 50 p.c. of horse serum, a concentration which was lethal to control cells. The phagocytosis of typhoid bacilli could also be increased by adding a vaccine to the culture medium. G. M. F.

The Morphology of Liver Cells grown in Tissue Culture.—L. DOLJANSKI ("Sur la morphologie des cultures pures de cellules hépatiques *in vitro*," *Compt. rend. Soc. de Biol.*, 1929, 102, 629-31). According to the writer, it is a comparatively simple matter to culture liver cells from the 8-day-old embryo chick. The cells are said to resemble normal liver cells morphologically, and to contain glycogen. After repeated sub-cultures, however, the power to form glycogen is lost. G. M. F.

The Effect of Silica on the Growth "in vitro" of Cultures of Pulmonary Cells.—A. POLICARD, S. DOUBROW, and M. BOUCHARLAT ("Sur le mécanisme de la silicose pulmonaire. Influence sur les cellules cultivées *in vitro* des poussières siliceuses provenant du travail au rocher dans les mines de houille," *Compt. rend. de l'Acad. des Sc.*, 1929, 189, 593-4). Quartz dust added to the culture medium in which lungs of embryo chicks are grown is phagocytosed by the reticulo-endothelial cells. Certain of these cells which have phagocytosed large amounts show degenerative changes in the cytoplasm. G. M. F.

Experiments on the Virus of Dengue.—G. BLANC and J. CAMINOPETROS ("Quelques données expérimentales sur le virus de la dengue," *Compt. rend. de l'Acad. des Sc.*, 1929, 189, 594-6). Serum from convalescent cases of yellow fever has no action either *in vivo* or *in vitro* on the virus of dengue. The virus of dengue, unlike that of yellow fever, passes Chamberland L₂ and L₃ candles at atmospheric pressure, when obtained from the bodies of *Stegomyia*. The virus of dengue persists in the blood of patients for at least five days, and can infect mosquitoes. G. M. F.

Phlebotomus and Dengue Fever.—I. J. KLIGLER ("Studies on the Etiology of Phlebotomus and Dengue Fever. I. Introduction," *Ann. Trop. Med. & Parasitol.*, 1928, 22, 143-50). The two diseases are well-defined entities in Palestine. Phlebotomus or sand-fly fever is endemic, and occurs annually during May-October, when *P. papatasi* prevails, lasts three days, and usually confers a definite and apparently lasting immunity. Dengue fever is not endemic, and occurs only at long intervals. In 1927 the epidemic appeared in Haifa in November, when sand-flies had practically disappeared. The disease lasted six days, was usually accompanied by a rash, a marked leucopenia with a marked predominance of large mononuclears, and the serum had a definite icteric tinge. Transmission to human volunteers confirmed previous observations that both diseases are caused by viruses, present in the blood serum during the beginning of the fever, which pass readily through Berkefeld filters. Immunity to sand-fly fever does not afford protection against dengue fever. G. M. F.

Phlebotomus and Dengue Fever.—I. J. KLIGLER and M. ASHNER ("II. Is a *Leptospira* the Causative Virus?" *Ann. Trop. Med. & Parasitol.*, 1928, 22, 151-9). Attempts were made to detect *Leptospira* in the blood of patients by prolonged centrifugation, improved culture technique, and by animal inoculation.

Blood from 16 cases of sand-fly fever and 9 of dengue fever was studied with negative results. Simultaneously a study was made of the insect vectors caught in infected houses or fed on patients, and of the survival of pathogenic and saprophytic *Leptospira* in *P. papatasi* and *Aedes ægypti*, the respective vectors of Phlebotomus and dengue fever. Several thousand sand-flies, caught at various times in infected houses and examined under the dark field after trituration in saline and fractional centrifugations, yielded negative results. Sand-flies infected on patients and examined by trituration or paraffin sections were also negative for *Leptospira* or other organisms. *P. papatasi* as well as *A. ægypti* fed on suspensions of *Leptospira* free themselves of these organisms after 36 to 48 hours in the former and 12 to 16 hours in the latter. It is concluded that *Leptospira* are not concerned in the causation of either sand-fly or dengue fever, and that the ætiologic agents belong to the class of ultra-visible filtrable viruses.

Biological Abstracts.

The Size of the Mammalian Egg.—C. G. HARTMAN ("How Large is the Mammalian Egg? A Review," *Quart. Rev. of Biol.*, 1929, 4, 373-88). In this interesting review the variations in size of the mammalian egg are discussed. For no species of mammal is there complete agreement, and extreme variations have been recorded, though there is evidence to suggest that the extremes in size of living eggs are not viable. The most probable size of the human egg is from 130-140 μ , while the maximum recorded is 184, and the minimum 117 μ .

G. M. F.

Glandular Secretion.—R. H. BOWEN ("The Cytology of Glandular Secretion," *Quart. Rev. Biol.*, 1929, 4, 299-324, 6 text-figs.). The review of glandular secretion, of which this is the first portion, represents the last work of the author, whose early death, at the age of thirty-seven, is an irreparable loss to biology. After a brief introduction and a historical approach to the subject, the following topics are discussed:—the individual cell as the basis of glandular activity; the morphology of secretion and the secretory cycle; the origin of secretion-droplets, and the rôle of the nucleus in secretion. The review, which does not lend itself to abstraction, should be read in the original by those interested.

G. M. F.

Spermatogenesis in Amphibia, with special reference to the Plastosomes.—JUN-ICHI MORITA ("Über die Spermatogenese bei Amphibien-Studien auf *Rana nigromaculata*, mit besonderer Berücksichtigung der Plastosomen," *Folia Anat. Jap.*, 1928, 6, 737-76, 2 pls., 1 text-fig.). The author describes a technic to demonstrate plastosomes in sections by Ag impregnation, gives detailed description of the form, quantity, and distribution of plastosomes in each generation of spermatocytogenesis and of spermatohistogenesis. Spermatocytogenesis, from the viewpoint of plastosomes, is divided into two periods: presynaptic stage or longitudinal growth period (synapsis stage included); postsynaptic stage or disintegrating period. Studies of spermatohistogenesis show that the acrosome is formed from plastosomal granules; plastochondria are present on the surface of the head; the middle piece is formed of one centriol, some plastosomal granules, and a portion of cytoplasm. In addition to the ordinary plastosomes (plastochondria, plastocontes and plastochondriomita), heterogeneous plastochohontes, "geglederte Plastokonten," are present. Lastly, polymorphism of the nucleus in the primary spermatogonia and absence of amitosis are described.

Biological Abstracts.

Modifications of Chondriosome and Lacunoma in the Intestinal Cells of *Gambusia holbrooki* during the Different Phases of Functional Activity and during Fasting.—M. TIRELLI ("Modificazioni del condrioma e del lacunoma nelle cellule intestinali di '*Gambusia holbrooki*' durante le diverse fasi dell'attività funzionale e durante il digiuno," *Atti R. Accad. Naz. Lincei. Cl. Sci. Fis. Mat. e Nat.*, 1928, 7, 255-9). During prolonged fasting the intestinal epithelial cells become intensely vacuolated, and the chondriosomes appear broken up into small granules as during the period of assimilation. The contrary process occurs during the stage of rest and reconstitution. Regarding the chondriosomes as a gelified colloidal substance and an essential constituent of the cell, the author maintains that this breaking up is due to a loss of water by the cytoplasm during the phases of assimilation and fasting. Corti's lacunoma, present only during the reconstruction period, has the function of keeping the colloidal substance in a high degree of dispersion. It represents a substance that will be utilised by the cytoplasm to permit the chondriosome to resume its filamentous aspect. *Biological Abstracts.*

The Infra-red in Cytology.—E. CALZAVARA and IVAN BERTRAND ("L'infra-rouge en cytologie," *Ann. Anat. Path. Med.-Chir.*, 1927, 4, 461-88, 1 pl., 9 text-figs.). Tissues stained well with the cyanines (formulæ given), which were used at the same time to sensitise photographic plates to the wave-length of light characteristic of the dye in the region of infra-red light. The photographs revealed structures not visible by the ordinary methods of photomicrography. The article deals largely with technic. *Biological Abstracts.*

Histology, Embryology, etc.

Chromosome Behaviour and Genetic Behaviour in *Sciara* (Diptera).—CHAS. W. METZ. ("II. Genetic Evidence of Selective Segregation in *S. coprophila*. III. Absence of Parthenogenesis in *S. coprophila*," *Zeitschr. induktive Abstammungs- und Vererbungslehre*, 1927, 45, 184-201). In the first spermatocyte division in *Sciara* cell division is unequal, and the smaller component containing chromosomes from one parent degenerates. Data have been collected to test this hypothesis that a selective segregation of chromosomes occurs at this division, based on the fact that a male should transmit only the genetic factors received from one parent. The mutant wing character "truncate," which is recessive and not sex-linked, was used. When reciprocal crosses are made of truncate and wild type flies, it is found that backcrosses of F₁ males give opposite results: males from truncate mothers transmit only the truncate allelomorph, males from wild-type mothers transmit only wild type. The genetic behaviour of the female seems to be of the usual Mendelian type. The genetic behaviour of the male is independent of the somatic constitution of the mother, i.e., the male transmits only the gene received from his mother, whether she is homozygous or heterozygous for it. It is possible to predict the result of any mating involving truncate. The genetic evidence supports the hypothesis that segregation is selective, and indicates that the eliminated chromosomes are paternal. The large "sex-limited" chromosomes are paternal, yet are retained, hence these must behave differently from the other chromosomes at division. The inheritance of the mutant character "truncate" indicates that parthenogenesis does not occur in *Sciara*. Truncate is transmitted from father to daughter as well as from father to son, hence the sperm contributes to the female zygote as well as to the male zygote. M. A.

Genetic Identification of the Sex Chromosomes in *Sciara* (Diptera).—

CHAS. W. METZ and SILKA S. ULLIAN (*Proc. Nat. Acad. Sci.* 1929, 15, 82-5). Data are given of the inheritance of a recessive mutant character, "swollen" wing veins, followed through ten generations, and showing typical sex-linked inheritance. From matings of heterozygous females by swollen males, the F_1 females, when crossed with wild stock, gave unisexual progeny, as usual in this species of *Sciara*. The male progenies gave offspring half "swollen" and half wild type. Female producers gave wild type and swollen daughters, showing they were heterozygous in the ratio of 433 : 218. In succeeding generations the inheritance has been that of a typical sex-linked character where the male is XY and the female XX. There must therefore be a pair of sex chromosomes other than the large sex-linked chromosomes found in the male; this leaves the rôle of the latter unexplained.

M. A.

Evidence that "Unisexual" Progenies in *Sciara* are Due to Selective Elimination of Gametes (Sperms).—

CHAS. W. METZ (*Amer. Nat.*, 1929, 63, 214-28). The offspring from a male by any one female are of only one sex. This could be due either to selective elimination of zygotes or of sperms. To test whether there occurs a differential mortality among the zygotes, a series of matings was made and counts carried out on—(1) the eggs soon after fertilisation; (2) the flies developing from them. It was found there was no differential mortality operating after the fertilised egg was laid. Females were examined at different times, after copulation, to ascertain whether this mortality occurred between mating and egg-laying, but no traces of degenerating eggs were found. No regular retention of the eggs by the female occurs in this form, and, as in *Drosophila*, the eggs are inseminated one by one as they pass from the oviduct immediately before they are laid. Hence it is concluded there is no selective elimination of zygotes, so that selective elimination or inactivation of the sperms must take place either in the sperm receptacles or by the agency of the egg.

M. A.

Evidence that the Female is Responsible for the Sex Ratio in *Sciara* (Diptera).—

MILDRED S. MOSES and CHAS. W. METZ (*Proc. Nat. Acad. Sci.*, 1928, 14, 928-30). Species of *Sciara* are of two kinds in respect of sex ratios:—(1) those in which pair matings give offspring entirely or almost entirely of one sex, either male or female, i.e., "unisexual"; (2) those in which pair matings give offspring of both sexes, but in ratios differing from 1 : 1. Experiments are described with species of type (1). It is concluded that the sex ratio is determined by the female, since a male may give daughters by one female and sons by another. The offspring of individual females are regularly of one sex even when mated with different males. It seems probable that in *S. coprophila* the eggs of any one female are fertilised by sperm from only one male, since individual females, homozygous for the recessive character "truncate," when mated with normal and with truncate males, gave offspring all normal or all truncate.

M. A.

Observations on Sex Ratio Determination in *Sciara* (Diptera).—

CHAS. W. METZ and MILDRED S. MOSES (*Proc. Nat. Acad. Sci.*, 1928, 14, 930-2). An attempt is made to analyse the genetic structure of the females of the two types, male-producing and female-producing, which occur in approximately equal proportions. It is assumed that each female is heterozygous for a pair of factors or chromosomes which are responsible for sex-ratio determination. The female-producing female is heterozygous and the male-producing female and the male are homozygous recessive for this factor. The evidence indicates that this sex-ratio

determination follows a Mendelian type of inheritance, based on a single pair of factors. It is not irrevocable, however, within a species. M. A.

The Inheritance of Thyroid Size and the Establishment of Thyroid Races in Ringdoves.—OSCAR RIDDLE (*Amer. Nat.*, 1929, 63, 385–409). Data concerning the formation of large or small “thyroid races” among ringdoves and the behaviour of thyroid size in crosses are presented, based on 24 ringdove races and the thyroids of nearly 2,000 healthy doves. The factors known to cause temporary and permanent change in thyroid size were eliminated: these include varying diet, age, confined caging, altitude, climate, sexual, psychic and reproductive states, and disease. Birds of diverse origin were selected. From the 24 races studied, four races with characteristically large thyroids and four races with characteristically small thyroids were definitely established. Crosses were made between races of large, intermediate, and small thyroids. Considering the average thyroid weight in each generation, the results are as follows:—Large thyroid \times large thyroid gives small thyroids in F_1 , F_2 and F_3 ; small \times small gives small thyroids in F_1 , F_2 and partly in F_3 ; intermediate \times intermediate tends to give intermediates in F_1 , F_2 and F_3 . It is not known how many genetic factors govern thyroid size, but it is suggested that more than one factor is involved. The question of dominance is not solved, but it is established that thyroid size is not sex-linked in inheritance. M. A.

Vascular Filaments of Lepidosiren.—J. T. CUNNINGHAM (“The Vascular Filaments on the Pelvic Limbs of Lepidosiren, their Function and Evolutionary Significance,” *Proc. Roy. Soc., B.*, 1929, 105, 484–93). During the breeding season papillæ, which occur on the pelvic limbs of the male Lepidosiren, develop into long bright red vascular filaments. These persist throughout the breeding period, during which the male fish remains in the nesting burrow with the eggs and larvæ. After this period the filaments disappear by atrophy of the tissues and disintegration, not by absorption. Various theories have been suggested to account for the occurrence of these filaments. Evidence is here brought forward in favour of the view that the normal function of the pelvic filaments of Lepidosiren is to give off oxygen for the respiration of the eggs and larvæ. If this view is correct, the organs would seem to be unique in the animal kingdom. G. M. F.

Thyroid and Growth.—F. S. HAMMETT (*Quart. Rev. of Biol.*, 1929, 4, 353–72, 9 text-figs.). As is well known, the activity of the thyroid gland depends on the amount of iodine present in the food, and this, again, is dependent on geographical conditions. Now, by altering the functional intensity of the thyroid gland, a modification of the weight interrelationships of the various organs occurs, and therefore, it is suggested, a modification of their relative functional intensity. If this is the case, it is probable that the cell chromosomes also react to a change in the chemical environment, and since, in the case of thyroid deficiency, the change is always in one direction over long periods of time, there is a potentially adequate mechanism whereby varieties within a species are producible, and the inheritance of acquired characters is possible. G. M. F.

Development of Amphibian Larvæ.—B. M. ALLEN (“The Influence of the Thyroid Gland and Hypophysis upon Growth and Development of Amphibian Larvæ,” *Quart. Rev. Biol.*, 1929, 4, 325–52, 8 text-figs.). The thyroid gland and pars anterior of the hypophysis are essential to the continuance of the process of development beyond a definite point characteristic of the species. Absence of either or of both will have the same effect. There is a complete dependence of

the development of the organism in all its parts, save possibly the gonads, upon the interaction of these two glands. The secretion thus formed is stored in the thyroid gland. The pars anterior of the hypophysis regulates growth in size, its influence, exerted by various methods of administration, being expressed by a rapid acceleration of growth, and probably also by causing its continuance beyond the period when it normally ceases. This stimulus is certainly sufficient to restore growth to normal when administered to individuals in which the pars anterior has been subnormal or absent, and it appears possible to stimulate growth to a fair degree beyond normal by administration of the pars anterior secretion in various appropriate ways. This function of the pars anterior of the hypophysis, whereby it induces growth in size, appears to be quite independent of the thyroid gland.

G. M. F.

Mollusca.

The Butter Clam, *Saxidomus giganteus*.—C. McL. FRASER and G. M. SMITH ("Notes on the Ecology of the Butter Clam, *Saxidomus giganteus* Deshayes," *Trans. Roy. Soc., Canada, Biol. Sc.*, 1928, 22, 271-86, 2 pls.). An examination of over 2,600 specimens of *Saxidomus* shows a general resemblance to *Paphia* in the manner in which it is affected by ecological conditions, but, as it may attain to a greater size and reach a greater age, some of the effects are accentuated. This is indicated in the greater number of marked "disturbance checks." In spite of this, the growth curve is more nearly uniform in trend at the various beaches, although the rapidity of increase varies with the beach. Here, too, clams in beaches near strong tidal currents grow more rapidly than those at the head of quiet bays. The year 1923 was the best of recent years for growth. Clams in their seventh year were most numerous and most widely distributed, but those in the years from the fourth to the tenth are all plentiful and well distributed. The nature of the beach has little to do with the rate of growth, but does seem to affect the length-breadth ratio of the shell. ♂♂ and ♀♀ are practically equal in size and number. Approximately half of the clams spawn for the first time at the end of the third year (at 45 mm.), nearly all the remainder at the end of the fourth year (55 mm.). Indications of spawning were obtained during July and August, but at a few of the beaches only. Ova and spermatozoa appear to be mature during the whole summer.

Biological Abstracts.

The Radula of *Limnæa* and *Bulinus*.—F. G. CAWSTON (*Nautilus*, 1928, 41, 141-2). A study of embryonic and mature radulæ of these genera shows that the absence of cones from the central tooth of *L. natalensis* and allied species, even in the anterior rows, is not due to wear and tear, but to lack of development. The purpose of the great number of teeth in these broad radulæ would seem to be to enable the radula to cover a broad surface of vegetable food.

Biological Abstracts.

The Anatomy and Life-History of a Freshwater Mollusc of the Genus *Sphærium*.—C. R. MONK (*J. Morph. & Physiol.*, 1928, 45, 473-504, 17 text-figs.). A detailed study was made of the anatomy of one of the finger-nail shells, and preliminary observations on the life-history have been carried out. In its general organisation *S. notatum* is very similar to the larger freshwater lamellibranchs. A gastric shield, crystalline style, the style sac, similar to those found in the stomach and intestine of *Lampsilis*, are present. A pair of slender muscles extending from the dorsal side of the body into the gills, apparently not previously described, were

found. The nervous system consists of the typical three pairs of lamellibranchiate ganglia, with their connectives, accessory ganglia, and nerve fibres. Particular study was given to the statocysts and osphradia, and attention is called to the fact that the function commonly ascribed to the osphradia is incompatible with their position in the roof of the cloacal chamber. *S. notatum*, like all the Sphæriidæ, is hermaphroditic and viviparous. The gonads are paired racemose glands lying behind and below the stomach. The sperm-producing follicles form the anterior portion of each gonad, and are somewhat smaller and more numerous than the ova-producing follicles which form the posterior portion. The young pass through the early stages of development in brood pouches in the gills, and are expelled as relatively enormous individuals. Preliminary observations on the life-history indicate that reproduction reaches its height in the summer, and that fertilisation probably takes place during the late summer and fall. *Biological Abstracts.*

Arthropoda.

Crustacea.

Development of the Spiny Lobster, *Panulirus japonicus* (v. Siebold).—ARATA TERAU (*Jap. Journ. Zool.*, 1929, 2, 387–449, 5 pls.). The development of this form is in many respects similar to that of the European lobster *Palinurus*, but some important features can be more clearly established in the Japanese genus. Thirty days elapse from the formation of the blastula to hatching, as a naupliosome larva and nine developmental stages are distinguished. Invagination is accompanied by extensive migration of endodermal cell to the interior, and this migration of cells (yolk cells) into the yolk mass continues at all stages. The proctodæum is identical in position with the blastopore. At the formation of appendage rudiments the ectoderm is raised into a sac-like swelling while cells sink inwards; no migration of mesoderm to these rudiments occurs. Transversely running depressions (lateral growth stripes) play an important part in constricting off the appendages from the egg surface. It is suggested the first pair of stripes occurring behind the optic discs have been mistaken for rudiments of preoral appendages in other forms. At a later stage two pairs of maxillæ and two pairs of maxillipeds appear in two formative zones, an anterior and a posterior. At first the second maxillæ are inwardly directed, and this is considered an ancestral condition found in *Branchipus*, a primitive form without oral appendages behind the maxillæ. A remarkable feature is the development of three dorsal organs, the anterior and the dorsal ones carrying on active secretion before degenerating. The middle dorsal is present in the late embryo, but in a rudimentary condition, and has been called the "dorsal plate." These organs, besides being excretory in function, separate the embryonic exuvia from the egg surface by liberation of secretion, and so serve as moulting glands. Simultaneously the embryo contracts longitudinally, probably a purely physical phenomenon due to the disturbance of the balance between the embryonic surface and the underlying yolk, which undergoes rapid liquefaction. Cœlom sacs form close to the bases of the first antennæ and succeeding limbs, but degenerate, with the exception of those under the first and second antennæ and second maxillæ. Those under the second antennæ persist as the glandular part of the antennæ glands. Cœlom sacs are also formed within the thoracico-abdominal fold. The heart, pericardial septa, and longitudinal muscles form the dorsal halves, while the ventral halves are transformed into a pair of gonad rudiments. This is compared with the gonad formation in Onchyophora, Annelida, and with other Decapoda. Throughout the development cell changes are followed with minute observation.

M. A.

Insecta.

Scent-Organs of Lepidoptera.—H. ELTRINGHAM ("On the Scent-Organs of *Opsiphanes cassiae lucullus* Fruhst. (*Lepidoptera*, *Brassicidæ*)," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 1, 1-4, 1 pl.). A description is given of the scent-organs of *Opsiphanes cassiae lucullus* Fruhst., based on a microscopical study, and the following conclusions are made by the author. The male butterfly is equipped with two separate and independent scent-organs, the different products of which may be simultaneously diffused, and produce an effect only obtainable by the "nascent" action of the chemical substances involved. On the other hand, one gland may be repugnatorial and the other sexual. This, however, seems unlikely, since neither structure is to be found in the female. In the genus *Heliconius* both sexes have repugnatorial glands, although in different positions (*Trans. Ent. Soc.*, 1925, p. 269), but in that genus the male has special scent-scales on the wings quite independent of the gland, and presumably homologous with the scent-scales of Pierine and other butterflies.
M. E. M.

Oxyhæmoglobin in Macrocorixa geoffroyi.—M. D. H. BRINDLEY ("On the Occurrence of Oxyhæmoglobin in *Macrocorixa geoffroyi* Leach," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 1, 5-6, 1 text-fig.). In 1922 a small Notonectid was collected by the author in British Guiana. The body contained a considerable quantity of red matter, which, from such tests as were applied at the time, appeared to be oxyhæmoglobin. The coloured matter was contained in large round cells disposed in a mass in the ventral body-cavity, and intimately connected with the tracheal system. On her return to England it appeared probable to the author that a similar condition might be found to exist in English water-bugs. In January, 1928, a red substance was found to be present in the male of the large water-boatman *Macrocorixa geoffroyi* Leach, and was subsequently proved to be oxyhæmoglobin. The hæmoglobin is found only in the accessory gland of the male genital system. A description is given of the anatomy of this organ, but the function of the oxyhæmoglobin in the accessory gland is unknown. Hæmoglobin is not found in the female of *M. geoffroyi*, nor, so far, in either sex of several smaller species of *Corixa* which have been examined.
M. E. M.

Collembola from Abyssinia.—E. HANDSCHIN ("Collembola from Abyssinia," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 1, 15-28, 3 text-figs.). The Collembola of Eastern Africa are scarcely known. There have been only six papers published during the last twenty-five years dealing with records from this part of Africa. A list of these papers is given, and to these records the present paper may be added. It contains the results of the determination of a collection of Collembola which was made by Dr. Hugh Scott and Mr. J. Omer Cooper in Central Abyssinia in 1926. The localities in which the material was collected are recorded. Although the collected material is small, it nevertheless gives an indication of the composition of the Collembolan fauna of the whole country, and permits a recognition of the affinity of the fauna with that of the surrounding regions. The following 12 species are recognised and described:—*Pseudachorutes mirabilis* n. sp., *Pseudachorutes handschini* Den. 1924, *Achorutes montanus* n. sp., *Lepidocyrtus cyaneus* Tullb. 1917, *Lepidocyrtinus subdomesticus* Den. 1924, *Lepidocyrtinus annulipes* n. sp., *Lepidocyrtinus cooperi* n. sp., *Paronella nigromaculata* Schött. 1923, *Dicranocentrus stachi* (Den.) E. H., *Dicranocentrus æthiopicus* n. sp., *Cyphoderus arcuatus* Wahlgr. *æthiopicus*, n. var., *Ptenothrix violacea* n. sp.
M. E. M.

Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, No. XIX," *Proc. Linn. Soc., N.S. Wales*, 1929, **54**, no. 222, pt. 2, 107–17, 11 text-figs.). Under the family *Mycetophilidæ* the author gives his recent decisions regarding the validity of certain genera after comparisons with the opinions of Mr. F. W. Edwards. Under the *Tachinidæ* descriptions of the following new species are presented:—*Hyalomyia nigrisquama* n. sp., *Hyalomyia lativentris* n. sp., *Hyalomyia lepidofera* n. sp., *Hyalomyia nigrihirta* n. sp., *Actia norma* n. sp. M. E. M.

Australian Pyrgotidæ.—M. BEZZI ("Australian Pyrgotidæ (Diptera)," *Proc. Linn. Soc., N.S. Wales*, **54**, no. 222, pt. 2, 1–31, 14 text-figs.). The *Pyrgotidæ*, formerly regarded as a sub-family of the *Ortalidæ*, are now separated as a distinct family of the *Ortalidiformes* series or of the *Tephritomorphæ* group. This last group is distinguished chiefly by the divergent, never convergent, post-vertical bristles, and the strongly chitinated and well-developed ovipositor of the females. The *Pyrgotidæ* are conspicuous flies, of large or medium size, rarely small; they are always of pale yellowish colour or reddish, and very often have variegated wings. These pale colours, it is said, are certainly related to the nocturnal habits of most of the species. The food of the adult flies is unknown, but they certainly do not feed on flowers. Some species may be predaceous, like the equally yellow and nocturnal *Bengalia*, etc., but they have more fleshy soft proboscides. The author gives a list of 88 previously-described species from all parts of the world, and then proceeds to consider the Australian genera and species. Keys are provided for the identification of the genera and species, and the following new genera and species are described:—*Mænomenus* n. gen., *Mænomenus ensifer* n. sp., *Toxura robusta* n. sp., *Toxura discoidalis* n. sp., *Epicerella plagiata* n. sp., *Epicerella setosa* n. sp., *Epicerella strumosa* n. sp., *Epicerella maculipennis* n. sp., *Epicerella minor* n. sp., *Acropyrgota cribripennis* n. sp., *Adapsilia illingworthana* n. sp., *Campylocera curvinnervis* n. sp., *Prodalmannea* n. gen., *Prodalmannea variabilis* n. sp., *Neotoxura* n. gen., *Epicerella triangularis* n. sp., *Epicerella multipunctata* n. sp., *Frontalia* n. gen., *Frontalia genalis* n. sp., *Campylocera hyalipennis* n. sp., *Nicholsonia* n. gen. Additionally, descriptions and records of previously-described genera and species are included. M. E. M.

Australian Coleoptera.—H. J. CARTER ("Australian Coleoptera: Notes and New Species—VI," *Proc. Linn. Soc., N.S. Wales*, 1929, **54**, no. 222, pt. 2, 65–79, 5 text-figs.). An identification table is given, and the following species are described:—*Lucanidæ*: *Rhyssonotus costatus* n. sp.; *Buprestidæ*: *Stigmodera (Themognatha) marginalis* n. sp.; *Stigmodera (Themognatha) particollis* n. sp.; *Stigmodera (Castiarina) duaringæ* n. sp.; *Stigmodera (Castiarina) sexualis* n. sp.; *Dascillidæ*: *Dascillus serraticornis* n. sp.; *Tenebrionidæ*: *Platydemia heroni* n. sp.; *Platydemia taylora* n. sp.; *Platycilibe wilsoni* n. sp.; *Bolbophanes (?) pallidipes* n. sp.; *Hemicyclus sphæroides* n. sp.; *Leptogastrus suttoni* n. sp.; *Cistelidæ*: *Hybrenia dentipes* n. sp.; *Hybrenia tibialis* n. sp.; *Cerambycidæ*: *Mesolita alternata* n. sp.; *Mesolita antennalis* n. sp. M. E. M.

Ceratopogoninæ from the Transvaal.—B. DE MEILLON ("Some *Ceratopogoninæ* from the Transvaal," *Trans. Ento. Soc., Lond.*, 1929, **77**, pt. 2, 245–9, 3 text-figs.). The recorded *Ceratopogoninæ* were collected during a mosquito survey in the Transvaal within the period January to April, 1928. Immature stages of midges collected with mosquitoes were separated and allowed to hatch, but no special efforts were made to collect them in the field. The following species, two of which are new, and are here described, constitute the collection:—*CULICOIDES* Latr.—*Culicoides schultzei* End.; *Culicoides bedfordi* Ing. & Macfie; *Culicoides accraensis*

Carter, Ing. & Macfie; *Culicoides punctithorax* Carter, Ing. & Macfie; BEZZIA Kieff.—*Bezzia africana* Ing. & Macfie; DASYHELEA Kieff.—*Dasyhelea nigrofusca* Carter, Ing. & Macfie; MONOHELEA Kieff.—*Monohlea nigeriae* Ing. & Macfie; STIOLOBEZZIA Kieff.—*Stiolobezzia linnophila* Ing. & Macfie; *Stiolobezzia spirogyrae* Carter, Ing. & Macfie; CERATOPOGON Meigen. Subgenus, *Brachypogon* Kieff.—*Brachypogon africana* n. sp.; PALPOMYIA Meigen.-Kieff.—*Palpomyia nigrithorax* n. sp. M. E. M.

Butterfly Migrations.—L. D. CLEARE ("Butterfly Migrations in British Guiana, II," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 251-64, 2 maps). In the present paper further observations on migration of butterflies are recorded, as well as observations in related phenomena, such as the swarming of the insects, reversal of flight, and notes with regard to the alleged food plant of the larvæ. The observations concern principally Pierid butterflies, and the species recorded are *Catopsilia sennæ* L. (under which name is included records attributed to *Callidryas eubule* L.; *C. statira* Cram.; *C. philea* L.; *C. agarithe* Bdv., and *Appias drusilla* Cram.). Other species and families have also been observed migrating, and these are *Cydimon leilus* L.; (URANIIDÆ), *Coeacadmus*, Cram. (NYMPHALIDÆ), *Selenophanes cassiope*, Cram. (NYMPHALIDÆ) and *Lignyostola criniscus* Cram. (HESPERIDÆ). Such migrations may comprise only one species, but may, and indeed often do, embrace several species. In one such migration now recorded eight species were involved.

M. E. M.

New Sense Organ in Lepidoptera.—H. ELTRINGHAM ("On a New Sense Organ in Certain Lepidoptera," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 471-3, 4 text-figs.). In the species under study the chætosemata are visible as oval convex bodies just behind the basal attachment of the antennæ. Close to the inner edge of each there can be seen a small papilla arising from the chitin of the top of the head and projecting forwards and slightly upwards. These two papillæ are the organs in question, and, being normally buried under the scale vestiture, are invisible unless the scales over this area are removed. The author gives a minute description of these organs, together with illustrations of their macroscopic and microscopic structure. Like the chætosemata, the organs are present in both sexes, and occur also in *Urania fulgens* and *Chrysidia ripheus*, though much reduced in the latter species. The definite nerve connection with the brain would seem to indicate a functional activity of the organ, but there is nothing in its simple, if not degenerate, structure to suggest what the function may be. Being buried in the general scaling of the head, it can be of no optical use. The moths in which it is found are already provided with auditory organs, and for the present its function must remain as great a mystery as that of the chætosemata itself.

M. E. M.

African Rhopalocera.—H. ELTRINGHAM, E. B. POULTON, N. D. RILEY and G. TALBOT ("African Rhopalocera: Descriptions and Notes," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 475-504, 2 pls., 2 text-figs.). This paper includes descriptions of three new species and several new subspecies.

M. E. M.

Gynandromorphism in Odonata.—F. R. RHEINAU ("Gynandromorphismus bei Odonaten," *Mitteilungen der schweizerischen Entomologischen Gesellschaft*, 1929, 14, Heft 3, 97-102, 3 text-figs.). The author discusses this condition in the following species:—*Calopteryx virgo*, *Calopteryx splendens*, *Rhyothemis phyllis* Snelleni.

M. E. M.

Studies on the Subfamily Agrotinæ.—A. CORTI ("Studien über die Subfamilie der *Agratinæ* (Lep.)," *Mitt. schweizn. Entom. Gesech.*, 1929, 14, Heft 3, 103–20, 8 text-figs.). The following species are included.—*Euxoa cos* Hb., the various forms of *cos*, *Euxoa catervaria* n. sp., *Euxoa powelli* Obthr. and v. *persubtilis* nov. var. *Euxoa doufanæ* Obth. The new species and new variety are described, and the male genitalia of the species are figured. M. E. M.

New African Geometridæ.—L. B. PROUT ("Nouvelles Geometridæ africaines," *Mitt. schweizn. Entom. Gesech.*, 1929, 14, Heft 3, 19–32). Dr. G. E. Audeoud has submitted to the author his collection of *Geometridæ* for determination, and 11 new species or subspecies have been recorded. Of these, 7 are common to the districts already mentioned by Joannis, but 4 are from new districts—namely, 3 from Kampala, Uganda, and 1 from Madagascar. The following species are described:—Subfamily, OENOCHROMINÆ.—*Diptychis meraca* n. sp.; HEMITHEINÆ.—*Prasinocyma stictoloma* n. sp.; *Heterorachis devocata mozambica*. subsp.; STERRHINÆ.—*Scopula (Pylarge) promethes* n. sp.; LARENTIINÆ.—*Rhodometra audeoudi* n. sp.; *Epirrhoë rhodopnoa* n. sp.; GEOMETRINÆ.—*Xanthisthisa tergorinota* n. sp.; *Hyostomodes ignava* n. sp.; *Nassunia aurantiaca* n. sp.; *Melinoëssa sodaliata lepturges* n. subsp.; *Melinoëssa tanyglochis* n. sp. M. E. M.

Revision of the Fissilabioidea.—F. C. FRASER ("A Revision of the *Fissilabioidea* (*Cordulegasteridæ*, *Petaliidæ* and *Petaluridæ*). Order Odonata. Pt. 1, *Cordulegasteridæ*," *Mems. Indian Mus.*, 1929, 9, no. 3, 69–167, 4 pls. and 35 text-figs.). This monograph aims at a continuation of those previous works which have dealt so adequately with the collections of the late Baron Edmond de Selys Longchamps, and which were arranged for by the sons of the "Father of Odonatology." As far as possible, the scheme of the work has been modelled on the lines of Ris's monograph on the *Libellulinæ*, and the author has to thank his mentor for this invaluable guide. In regard to the Selysian collection, it is to be regretted that a part was lost when the P. & O. steamship "Egypt" was mined and sunk off Ushant, as this ship was conveying the insects to Australia for Dr. Tillyard's examination. Fortunately, duplicates of some of these, especially of Indian material, have come into the possession of the author, or the loss would have been irreparable. This loss explains several hiatuses in the collection, and is expressed by the names of the species being enclosed in brackets. M. E. M.

Arthropod Hosts of Helminths.—M. C. HALL ("Arthropods as Intermediate Hosts of Helminths," *Smiths. Misc. Colls.*, Wash., 1929, 81, no. 15, 1–77.) The lists of heteroxenous worms and their arthropod hosts given in this paper are the most complete of those published, and the omissions are probably few. The lists for certain groups have been compiled from time to time, some of the more important and more recent being those of Seurat (1916, 1919), MacGregor (1917), Joyeux (1920), Ransom (1921), Van Zwaluwenburg (1928), and Henninger (1928), and the catalogues of Stiles & Hassall, but no previous paper has attempted to cover all the arthropod hosts of the parasitic worms of vertebrates. On the basis of the lists given here, this paper includes a consideration of the general facts and of the broad principles which may be derived from a correlation of these facts. While it will serve as a reference for the trained scientist in the groups involved, its principal value will be as a reference and guide to younger workers and students, and to investigators who work in places remote from adequate library facilities and the specialised literature on arthropods or parasitic worms.

M. E. M.

Morphogenesis in the Muscoid Diptera.—W. R. THOMPSON ("A Contribution to the Study of Morphogenesis in the Muscoid Diptera," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 191-234, 30 text-figs.). The present paper, which is an outgrowth of a Monographic Study of the Larvæ of some Muscoid Diptera, published some years ago, comprises: (1) an attempt to explain a number of the more obvious morphological characteristics of these creatures as due to the interaction of relatively simple factors, susceptible, at least in some degree, to mathematical treatment, and (2) a discussion of the general significance of the physico-mathematical method as applied to the problems of organic form and movement. No special effort was made to find materials specially adapted for morphogenetic studies. All of the problems here studied suggested themselves naturally during the course of work carried on with a quite different object; every one of them could be made, with profit, the subject of an extensive and interesting investigation. In the author's opinion the question of the value of the physico-mathematical method, as applied to biological problems, has given rise to a great deal of vague, though emphatic, argument and confused thinking. It demands a more elaborate and detailed treatment than it is possible to give within the limits of a paper like this. Nevertheless, it is hoped that the analytical study comprising the second half of this paper, though containing only the bare skeleton of a solution, will help to clear up what is certainly one of the most interesting problems of general biology.

M. E. M.

Central American and West Indian Hymenoptera.—L. E. CHEESMAN ("Hymenoptera Collected on the 'St. George' Expedition in Central America and the West Indies," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 141-54, 9 text-figs.). The hymenoptera described form part of a collection of insects made while on the "St. George" Expedition of the Pacific (1924-1925), with additional material collected on Martinique and La Guadeloupe after leaving the expedition. In the first part of the time the yacht paid visits of varying duration to Trinidad, B.W.I., the Panama zone (including Taboga Island), Coiba Island, Costa Rica, Isla del Rey, Pearl Island, Gorgona Island, Colombia, and the Galapagos Island. No encampments were formed, but daily expeditions were made from the yacht. In the second part of the time the expedition proceeded south-west and visited islands of the Marquesas, Tuamatu, and Society Groups. The collection of insects made upon these island groups of the South-East Pacific has been worked out separately and the results published. Gorgona Island possesses a rich insect fauna which is mainly Central American, many of the species being also found in South Mexico. The descriptions of a large number of new species are included in this paper.

M. E. M.

Gall-Making Coccids: New Species.—W. W. FROGGATT ("Notes on Gall-Making Coccids, with Descriptions of New Species," *Proc. Linn. Soc., N.S. Wales*, 1929, 54, pt. 4, no. 224, 375-8, 2 pls.). Since the author's "Descriptive Catalogue of the Scale Insects (*Coccidæ*) of Australia" was issued in 1921, he has collected a large number of new species of coccids upon the native trees, and noted new host plants of others previously recorded. He has also had other specimens from correspondents in different parts of the Commonwealth, either new species or examples extending the range of previously-described species. In these notes some of the gall-making species are dealt with, including *Apiomorpha macqueeni* n. sp., *Opisthoscelis conveza* n. sp., *Opisthoscelis globosa* n. sp., *Opisthoscelis recurva* n. sp.

M. E. M.

Australian Geometridæ.—G. M. GOLDFINCH ("Revision of the Australian Geometridæ (*Lepidoptera*)," *Proc. Linn. Soc., N.S. Wales*, 1929, 54, pt. 4, no. 224,

379-407, 2 pls., 4 text-figs.). The author has ventured to prepare the present paper, which is intended to be a revision of the Australian species which fall under groups 1 and 2 in Mr. L. B. Prout's monograph of the family (*Genera Insectorum*, fasc., 1912, 129). This attempt, it is hoped, will help to unravel some of the difficulties which have confronted Australian lepidopterists working in the group. Descriptions are given of new genera and species, with keys for the identification of all the species referred to.

M. E. M.

Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XXI," *Proc. Linn. Soc., N.S. Wales*, 1929, 54, pt. 4, no. 224, 408-10, 7 text-figs.). By a careful examination of all the Australian material made available to the author by the United States National Museum, he has been able to identify amongst this the following four species generally placed in *Ommatius*:—*Ommatius chinensis* Fabricius, *Ommatius distinctus* Ricardo, *Ommatius queenslandi* Ricardo, *Ommatius flavicaudus* n. sp. Notes are given on the first three species, together with a description of the male and female of the fourth species.

M. E. M.

Generic Names of Microlepidoptera.—T. B. FLETCHER ("A List of the Generic Names Used for the Microlepidoptera," *Mems. Dept. Agric. India, Ento. Series*, 1929, 11, 1-244). The compilation of this list of generic names used in Microlepidopterology was begun upwards of twenty years ago in connection with the study of Indian *Microlepidoptera*. The *Microlepidoptera*, as this term is generally understood, do not form any definable group, many families, comprising the larger forms, having been appropriated as a legacy of the times when they were grouped as part of the "*Bombyces*" by the students of the larger moths. Such families, excluded from consideration in the present work, are exemplified by the *Hepialidæ*, *Heterogeneidæ* (*Limacodidæ*), *Zygænidæ*, *Psychidæ*, *Cossidæ*, and *Pyrалidæ*. The author gives a table of the families included in his list, together with a short explanatory preface of nine additional pages, and a separate index.

M. E. M.

Grouse-Locusts of Madagascar.—J. A. G. REHN ("New and Little-Known Madagascar Grouse-Locusts (*Orthoptera*, *Acrididæ*, *Acrydiinæ*)," *Acad. Nat. Sci., Philadelphia*, 1929, 81, 477-519, 5 pls.). The material on which the present paper is based was collected some years ago by M. Lamberton of Tananarive, Madagascar. From available evidence it would seem that the whole of the collection of locusts came in its entirety from the eastern forest belt of the island. A description is given of several new genera and species.

M. E. M.

Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XX," *Proc. Linn. Soc., N.S. Wales*, 1929, 54, pt. 4, no. 224, 283-343, 34 text-figs.). This paper contains notes on Calyptrate Diptera only, and is intended as a final contribution on the genus *Rutilia*.

M. E. M.

Principles of Systematic Entomology.—G. F. FERRIS ("The Principles of Systematic Entomology," *Stanford Univ. Publ., Univ. Series, Biol. Sci.*, 1928, 5, no. 3, 1-169, 11 text-figs.). It is primarily as a discussion of the fundamental principles and of the philosophical background of systematic entomology that this volume is presented, since there seems no single book to which one may turn for a discussion of the principles on which the present work is based. However, to give reality to any such philosophical discussion it is necessary also that the means by which these principles may be applied shall also be considered, to some extent at least. Consequently, although this book is not intended as a manual of detailed

methods, there will be found a general discussion of them, more or less detailed in the case of things which have not been extensively treated elsewhere. As a matter of convenience for systematists, there is included a reprint of the international code of nomenclature. This volume is a frankly critical survey of the existing conditions in systematic entomology, and in 12 chapters deals with: The Contribution of Systematists to Biology, The Scope of Systematic Biology, The Principles of Systematic Entomology, The Segregation of Species, Categories Less than the Species, The Morphological Basis of Systematic Entomology, The Preparation of Material, Entomological Drafting, The Description of Species, Classification, Nomenclature, and The Training of the Systematist. M. E. M.

Reactions of Whirligig Beetles.—C. R. BROWN and M. H. HATCH ("Orientation and "Fright" Reactions of Whirligig Beetles (*Gyrinidae*)," *Journ. Comp. Psychology*, 1929, 9, no. 2, 159-89). The following is extracted from the authors' summary. In the laboratory the stream-dwelling *Dineutus discolor* Aubé and pond-dwelling species of *Dineutus* and *Gyrinus* orientated themselves in accordance with the direction of the light source, visible either to their dorsal or ventral eyes. No orientation to complex patterns as such was obtained. When the only light source was submarine, diving toward it was a frequent reaction. In the dark, in the laboratory, disorientation was complete. The beetles did not necessarily cease swimming actively, but the swarm gradually dispersed, because all its members were completely disorientated. No gregariousness in the dark was noted. The gyrenids did not show by their behaviour that they detected any difference between standing and running water or the direction of the current. On the contrary, orientation had an exclusively visual basis. In the field, orientation with respect to the direction of light, or of relative position of light and dark portions of the visual field, may account for some of the observed behaviour. But orientation to patterns must still be postulated for the greater part. In their natural habitat the "fright" reaction to stimuli of minimal or nearly minimal size was elicited only when the stimulus increased the complexity of the visual field. Decreases in complexity produced no visible reaction. Changes of brightness of small portions of the visual field were, as such, without visible effect. Reaction to the appearance of a spot seems to occur only after a period of habituation to the less complex visual pattern. The period required for sufficient habituation is variable, averaging approximately one minute. The minimum area of surface whose abrupt change from white to black or *vice versa* could elicit visible reaction is one of about 76 sq. deg., or a circular spot subtending a plane angle of 10°. M. E. M.

Effects of Duration and Intensity of Light on Aphids.—A. FRANKLIN SHULL ("The Effect of the Intensity and Duration of Light and of Duration of Darkness, partly modified by Temperature, upon Wing-Production in Aphids," *Wilhelm Roux, Archiv. für Entwicklungsmechanik der Organismen*, 1929, 115 Band, 4-5 Heft, 825-51). When the parent aphids were alternated once a day between light of low intensity and total darkness, for periods ranging (for the light) from 5 minutes to 24 hours, the number of offspring having wings increased with increase in the duration of light up to 8 hours of light, decreased slightly thereafter up to 12 hours of light, dropped suddenly as the duration of light increased from 12 to 14 hours, and remained low for all longer periods of light. When more intense light was used, with the same periods of alternation, the curve of wing-production was higher for all durations of light up to 12 hours, but was nearly identical with the curve for low intensity for all daily durations of light greater than 12 hours. Single exposures to light or to darkness produced relatively

small and highly irregular effects on wing-production. To obtain many of the results obtained in the author's experiments, the exposures must be repeated. Nevertheless, an initial period of darkness of 12 hours or more, which by itself was shown to have little effect, followed by alternations of short periods of light and darkness (2 and 4 hours, and 3 and 6 hours) which also had relatively small effect by itself, caused a distinct increase of wing-production. In this sense a single period of darkness was effective. Sex-determination, in a sense, is stated to be controllable through wing-production. Since, under usual conditions, almost all males are produced by wingless mothers, and almost all gamic females by winged mothers, control of wings in one generation means virtual control of sex in the following generation in so far as gamic individuals are produced in the latter generation. To explain the control of wing-production by light and darkness, it is assumed by the author that some substance is produced in the light, that this is converted into another substance in darkness, that the second substance is reconverted into the first when light returns or is otherwise consumed, and that wings are produced, either when the second substance is present in a certain concentration or when it bears a certain quantitative relation to the first substance. High temperature is stated to inhibit some part of the process. M. E. M.

Modification of Berlese's Mountant.—B. A. R. GATER ("An Improved Method of Mounting Mosquito Larvæ," *Bull. Entom. Research*, 1929, 19, pt. 4, 367-8). While working on mites, the writer used the medium evolved by Berlese, as given by Bolles Lee and recommended by Imms for small arthropods. This medium was tried on mosquito larvæ, and although it was too fluid for making satisfactory permanent mounts, the results were so good that a number of modifications were made up by the writer. The formula which finally proved most successful was as follows:—distilled water 10 p.c., gum arabic, picked, 8 p.c., chloral hydrate 74 p.c., glucose syrup 5 p.c., acetic acid, glacial, 3 p.c. The ingredients were dissolved in the order named, preferably on a waterbath or in an oven at about 50° C. The fluid should be filtered by means of a Buchner funnel and suction-pump, using a No. 5 Whatman paper. This takes some time, but small quantities can be clarified quickly in the centrifuge. Glucose syrup was made by dissolving 98 gm. of bacteriological glucose in a 100 c.cm. of distilled water. The writer adds cocaine hydrochloride 0.3 p.c., and reduces the acetic acid to 2.7 p.c., but although rather more satisfactory mounts are stated to be obtained in this way, the cocaine is not essential. This solution is stated to effect fairly rapid clearing even of highly-pigmented species, and, as a mounting medium, to dry within three weeks even in the humid atmosphere of Malaya. After drying, the slides are ringed with celluloid varnish and asphaltum to produce permanent mounts. M. E. M.

The Adelginæ of North America.—P. N. ANNAND ("A Contribution Towards a Monograph of the Adelginæ (*Phylloxeridæ*) of North America," *Stanford Univ. Publ., Univ. Series, Biol. Sci.* 1928, 6, no. 1, 1-146). This paper embodies the results of work started in 1922 at the instigation of Prof. G. F. Ferris, of Stanford University. It lays no claim to completeness, nor is all the material included the result solely of the author's investigation. It has been his object to describe and figure all the known American species in such a way that they can be readily recognised in as many stages as possible, to review the more important facts already known regarding the various species, and to make more readily available results of the work of European scientists on this difficult and greatly confused group. In addition to this, contributions in the form of life-

history studies, descriptions of new species which have appeared during the preparation of this paper, and other contributions of entirely new material which the author has been able to make, are included. It is hoped by the author that the gaps, evident to himself, may at least be suggestive of problems awaiting the attack of favourably situated workers, and that this contribution, incomplete though it is, may serve as a starting-point for other American contributions to the biology and taxonomy of this interesting subfamily. In an introduction the scope and methods of the present work are outlined, with some account of the difficulties involved in the work with Adelgids. A review of the previous work is given, and the general morphology is then discussed before the author proceeds to an account of the complexities of the life-cycle and general biology of the *Adelginæ*. The remainder of the work is concerned with the taxonomic treatment, wherein descriptions of the various species are given, including their life-histories and distribution, their habitats, and the extent and type of the injury they inflict upon their host plants. M. E. M.

Pacific Pyrales.—E. MEYRICK ("Pacific Pyrales of the 'St. George' Expedition," *Trans. Entom. Soc., Lond.*, 1929, 77, pt. 2, 155–69). The present paper gives the results of the investigation by the author of the *Pyrales* collected by the "St. George" Expedition. The number of specimens in determinable condition was 1071, representing 56 species; of these, two genera and 29 species are described as new. Only 4 families of the *Pyralidina* are represented, and of these a single species of *Galleriidae* certainly, and in all probability the two species of *Pyralidae* also, were introduced by human agency. The extensive family *Crambidae* has no representative, although its simple larval requirements—grasses and moss—are found everywhere. Of the 53 species of *Phycitidae* and *Pyraustidae*, 18 are insects occurring also in the Australian or Papuan regions, and generally ranging much further to India or Africa, sometimes throughout the hot regions of the world. Some of these have great travelling powers (probably readily submitting to be carried by strong winds) and adaptability in respect of food plants; others are doubtless transported by man: these must be set apart from the true native fauna. One other species, *Piletocera signiferalis*, ranges widely in the Pacific from the Caroline Islands to Rapa, but is not recorded elsewhere. Its habits do not seem to be known, but it has probably been spread by native canoes. The remaining 34 species, so far as known, are all endemic, and constitute the interesting portion of the collections. All the species are named and their localities noted, while the author, additionally, gives descriptions of the new species. M. E. M.

Australian Thysanoptera.—R. S. BAGNALL ("On a Group of Minute Australian *Thysanoptera* (*Tubulifera*) and Their Associations with the So-called Leaf-Glands on *Acacia*," *Trans. Ento. Soc., Lond.*, 1929, 77, pt. 2, 171–6). This memoir deals with a group of minute Australian thrips allied to the American genera *Scopæothrips* and *Rhopalothrips* Hood. The group consists of the following genera and species:—Genus: *Scopæothrips* Hood (species American); *S. unicolor* Hood, from *Opuntia*. Genus: *Rhopalothrips* Hood (species American); *R. bicolor* Hood, from *Opuntia*. Genus: *Rhopalothripoides* nov. (species Australian); *R. brunneus* (Bagn.), from *Acacia dealbata*; *R. kellyanus* sp. n.; from *Acacia dealbata* with *R. brunneus*; *R. froggatti* (Bagn.), from leaf-glands of *Acacia decurrens*. Genus: *Froggattothrips* nov. (species Australian); *F. acaciæ* sp. n. from Wattle (*Acacia* sp.); *F. inconsequens* sp. n. from Wattle with *F. acaciæ* sp. n. M. E. M.

Geometridæ from French Oceania.—L. B. PROUT ("The Geometridæ of the 'St. George' Expedition from French Oceania," *Trans. Ento. Soc., Lond.*, 1929,

77, pt. 2, 265-77). Eighteen species, nine of which are new, are described. The localities dealt with are those enumerated by Mr. C. L. Collenette in vol. 76 of the *Trans. Ento. Soc., Lond.*, pt. 2, 469, and the bibliographical references which he there gives should be consulted, together with the zoogeographical discussion by Mr. E. Meyrick on pp. 489-91 of the same publication, in which he suggests employing the name of Palæonesia for the hypothetical land area, which seems to offer the only intelligible explanation of the general faunistic homogeneity of these islands, now so widely sundered. The *Geometridæ* of the region, as the included list shows, are by no means rich in species, and it is scarcely an exaggeration to say that the collections are made up almost entirely of the three genera *Chloroclystis*, *Gymnoscelis*, and *Cleora*.
M. E. M.

British Chironomidæ.—F. W. EDWARDS ("British Non-Biting Midges (*Diptera, Chironomidæ*)," *Trans. Ento. Soc., Lond.*, 1929, pt. 2, 279-430, 2 pls., 15 text-figs.). This paper (a sequel to one on the Biting Midges, published in the same Transactions for December, 1926) embodies the results of a number of years' work on the *Chironomidæ*, and includes keys to, and brief descriptions of, all the species hitherto found in this country. According to the author's statement, it is, nevertheless, far from being a complete account of our fauna. In the first place, the author considers that it is certain a great many species remain undiscovered, because a single day's collecting in any favourable locality still rarely fails to produce one or more additions to the total. Secondly, our knowledge of the distribution of the known species is still very meagre, and many which appear rare are probably widely spread and common in some districts. Thirdly, almost nothing has been done here by way of rearing these insects, and until this omission has been remedied no true idea of their relationships or of specific limits can be obtained, nor can the nomenclature be correlated fully with that employed by Continental workers. In the meantime, however, it appears desirable to publish a preliminary revision confined to a consideration of the adults, which will serve as a basis for further work and for the identification of at least the majority of the commonest species. The total number of British species recognised in this paper is 373 (nearly three times the number mentioned in Verrall's list of 1901); of these, 83 are described as new.
M. E. M.

Annelida.

Some Abnormalities in the Earthworm *Lumbricus terrestris* L.—B. R. COONFIELD (*Trans. Am. Micr. Soc.*, 1929, 48, 314-17, 1 text-fig.). Among 300 preserved earthworms from the Marine Biological Laboratory, Woods Hole, certain were found to possess extra spermiducal pores. Four, in addition to the normal pair of spermiducal pores in somite 15, had a single glandular papilla in somite 16 on the left side of the animal, while 8 specimens exhibited a pair of glandular papillæ in each of somites 15 and 16. All internal organs were normal except the sperm ducts.
G. M. F.

Platyhelminthes.

Trematoda.

The Trematode Family Bucephalidæ.—A. E. WOODHEAD ("Life-History Studies on the Trematode Family Bucephalidæ," *Trans. Am. Micr. Soc.*, 1929, 48, 256-75, 1 pl.). *Bucephalus papillosus*, a gasterostomatous trematode from fresh-water bass, is described and figured in all stages of its life-history, the miracidium of a gasterostome being described in detail for the first time. The miracidium is

equipped with 4 cephalic plates covered with long cilia, and 3 pairs of posterior jointed appendages, also bearing long cilia. Both the embryology of the cercaria and the penetration into small fish are described. G. M. F.

A Large-Tailed Echinostome Cercaria from North America.—H. M. MILLER, Jr. (*Trans. Am. Micr. Soc.*, 1929, **48**, 310–13, 4 text-figs.). During the course of an examination of several small species of Planorbis collected from Sportsman's Lake, San Juan Island, Washington, an echinostome larval trematode with a huge tail was found. *Cercaria cila* nov. spec. is the first of this type of echinostome larva to be reported from the United States. It was present in 6 p.c. of the snails examined. The only other large-tailed echinostome larva described is *Cercaria caudadena*, Faust 1921, parasitic in *Planorbis pfefferi* from South Africa. G. M. F.

Nematoda.

Gordiidae as Parasites of Man.—W. RIDDELL (*Centralbl. f. Bakt. I. Abt. Orig.*, 1928, **109**, 331–8). A summary is given of all cases hitherto recorded, correcting and extending previously-published lists. The first case in the British Isles is recorded from Northern Ireland, species *Gordius aquaticus* L. (= *G. villoti* Rosa), host a child aged 12 months. It is shown that *Ophistoma pontieri* Cloquet cannot be accepted as a synonym of *Parachordodes tolosanus* (Duj). The clinical importance is briefly discussed. Reasons are given for disagreeing with the commonly-accepted account of the life-history of Gordiidae. *Biological Abstracts.*

Cœlenterata.

Studies on the Hydras of North America.—L. H. HYMAN ("Taxonomic Studies on the Hydras of North America. I. General Remarks and Description of *Hydra americana* n. sp.," *Trans. Am. Micr. Soc.*, 1929, **48**, 242–55, 2 pls.). No adequate description of North American hydras has ever been published, probably owing to the fact that the names of European species have been applied somewhat indiscriminately to American forms. The only species certainly common to both continents is *Pelmatohydra oligactis* (= *Hydra oligactis*. Pallas. *H. fusca*. Liu.). A new species, *H. americana*, is described. This is the common white Hydra of the United States, usually but erroneously known as *H. vulgaris*, from which species it is, however, unquestionably distinct. G. M. F.

Protozoa.

Zone-Markers in the Spanish Eocene.—F. G. LLUECA ("Algunos foraminíferos de interés para el conocimiento de las formaciones eocenas de Gurb (Vich)," *Bol. R. Soc. Espan. Hist. Nat.*, 1929, **29**, no. 6, 247–50, 1 pl.). The blue marls of Gurb, near the town of Vich, are full of fossils, including abundant Orbitoids, accompanied, though in lesser numbers, by *Operculina alpina* Douv. From the abundant collection identified, 7 species are selected and figured because of their recognised value as markers for establishing the various zones of the formation, viz., *Discocyclus archiaci* Schlumb., *D. pratti* Michelin, *Asterodiscus stellaris* Brunner, *A. taramellii* Munier-Chalmas, *Actinocyclus furcata* Rutimeyer, *A. radians* d'Archiac, *A. varicosata* Gümbel. The plate shows good photographic figures of these species. A. E.

A New Locality for Choffatella.—F. G. LLUECA ("Nota sobre la existencia de la *Choffatella decipiens* Schlumberger en el Aptense de España," *Bol. R. Soc. Espan. Hist. Nat.*, 1929, **29**, no. 6, 245–6, 1 text-fig.). Records the discovery in

the Aptian of Morella (Castellón) and San Vicente de la Barguera (Santander) of considerable numbers of specimens which have been identified with Schlumberger's species, known hitherto only from the Gault of Portugal and the Aptian of Isère. Both megaspheric and microspheric forms have been found. A. E.

Patellina in the North Pacific.—DOROTHY K. PALMER ("A Note on the Occurrence of *Patellina corrugata* Williamson in the San Juan Archipelago, Washington," *Journ. Paleont.*, 1929, 3, no. 3, 306-7). Four specimens from a dredging in 100-150 metres outside the entrance to Friday Harbour, San Juan Island, constitute the first record of this species in the Eastern North Pacific. They are, without doubt, referable to Williamson's species, which has now been recorded from littoral and shallow water in nearly every quarter of the globe, although the number of specimens found is usually very limited, except in its first recorded habitat, Great Britain, where it is frequently abundant. A. E.

Foraminiferous Limestone from Sumatra.—I. M. VAN DER VLIERK and J. H. L. WENNEKERS ("Einige foraminiferenführende Kalksteine aus Süd-Palembang (Sumatra)," *Ec. geol. Helvet.*, 1929, Band 22, no. 2, 166-72, 1 pl., 1 text-fig.). A further study of material collected by Dr. A. Tobler in 1901, H. Douvillé having already published a paper on the material in 1915. It contains a list of the species observed, mostly Orbitoids, the majority of which could only be studied in sections, and some observations on the age of the deposits. The figures are apparently reproduced from photographs of the sections, and are rather obscure. A. E.

Philippine Foraminifera.—H. YABE and S. HANZAWA ("Tertiary Foraminiferous Rocks of the Philippines," *Science Reports, Tôhoku Imp. Univ., Sendai, Japan*, 2nd ser. (Geology), 11, no. 3, 137-90, pls. 15-27, 1 table). A collection of some 80 rock samples from various Philippine islands proved to be of Tertiary age, and, with few exceptions, rich in foraminifera. The specimens are certainly derived from several different geological horizons, and their constituent foraminifera are very varied. The great majority contained more or less foraminifera of large size, but 9 were *Globigerina* rocks poor in the larger forms. There is a description of each sample, recording its main constituents, followed by a detailed study of the 55 larger species discovered, the whole being superbly illustrated by a series of plates reproducing photographs of the species in section. A. E.

Eocene Alveolinas.—A. SILVESTRI ("Sul modo di presentarsi delle Alveoline eoceniche nei loro giacimenti primari," *Mem. Pont. Accad. delle Sci.—I Nuovi Lincei*, 12, 465-92, 3 pls., 3 text-figs.). A study of the genus *Alveolina*, well illustrated by sections of the various species found in the Lower Lutetian limestone of Barroubio, near Félins, in Languedoc. A. E.

Miocene Foraminifera of Sardinia.—GIULIA DEGLI INNOCENTI ("Foraminifere mioceniche di Sardegna," *Mem. Pont. Accad. delle Scienze—I Nuovi Lincei*, 1929, 12, 331-418, 1 pl.). The Miocene is largely represented in Sardinia and often rich in fossils. Certain groups have been well studied, but there is a gap as regards the microfauna, which often have a special value as evidence of the depth and conditions under which deposits were laid down. The various zones and their characteristic foraminifera are described, and an attempt made to estimate their bathymetrical significance. The depths appear to range from sublittoral deposits down to 300-400 fathoms. One hundred and sixty-six forms, including 3 new species and 5 new varieties, are dealt with, and it is estimated that only 14 p.c.

of them are extinct. The fauna has many points in common with the Miocene of Vienna, as studied by d'Orbigny, Karrer, Reuss and Czjzek. There is an extensive bibliography, chiefly Italian. A. E.

Fossil Foraminifera from North-East Borneo.—I. M. VAN DER VLERK ("Groote foraminiferen van N.O. Borneo," *Wetenschappelijke Mededeelingen van den Dienst van den Mijnbouw*, 1929, 9, 1-44, 7 pls.). Describes the larger foraminifera contained in Dr. Leupold's rock specimens from North-East Borneo, arranged in geological age, and lists the species which have been found reliable as "guide-fossils." There is a folding chart showing the geological distribution of 51 species and varieties, and the paper is copiously illustrated, mostly from photographs taken by ultra-violet light. A. E.

A New *Lepidocyclina* from Sumatra.—J. H. F. UMBGROVE ("Lepidocyclina transiens, sp. nov. van Sumatra," *Wetenschappelijke Mededeelingen van den Dienst van den Mijnbouw*, 1929, 9, 109-13, 1 pl.). The new species has been found at two localities in Southern Sumatra. The stratigraphical horizon is not yet fixed, but is probably the Upper Miocene. Its most characteristic features are the large nucleo-conch with thin walls, often showing irregular cavities, the irregular outline of the fossil, the absence of pillars, and the thin-walled lateral chambers, which increase in size towards the centre. A. E.

Tertiary Foraminifera from Venezuela.—J. A. CUSHMAN ("A Late Tertiary Fauna of Venezuela and Other Related Regions," *Cont. Cush. Lab. For. Res.*, 1929, 4, 77-101, 3 pls.). Material collected in the district of Zemorra, Venezuela, and reputed to be Miocene, proves to be identical with a collection from Manta, Ecuador, which has already been described by Galloway and Morrey as of Upper Eocene age (*Bull. Amer. Pal.*, 1929, 15, no. 55). The Venezuela collection has practically all the Ecuador species, with some additions. Both are closely related to Trinidad faunas usually regarded as Miocene, and it can be definitely stated that the Venezuela and Ecuador material is much younger than Eocene. Many of the species are widely distributed in the later Oligocene, and especially the Miocene of America and Europe. Six new species are described and figured, and a new genus, *Pseudoglandulina*, is created. The new genus is proposed for the reception of true *Nodosorix* with embracing chambers in substitution for *Glandulina* d'Orbigny, which is stated by the author to be polymorphine in the early stages—at any rate, in the microspheric form. A paper discussing this subject is promised. The illustrations are good. A. E.

Recent Californian Foraminifera.—C. C. CHURCH ("Some Recent Shallow Water Foraminifera Dredged Near Santa Catalina Island, California," *Journ. Palaeont.*, 1929, 3, no. 3, 302-5, 3 text-figs.). Eight large species, two of which are new, were found in screened material which had been dredged for the purpose of collecting mollusca. Owing to the coarseness of the screen, only the largest species were retained. Very little is known of the fauna of this area, and the records are therefore of interest. A. E.

Californian Cretaceous Foraminifera.—J. A. CUSHMAN and C. C. CHURCH ("Some Upper Cretaceous Foraminifera from near Coalinga, California," *Proc. Calif. Acad. Sci.*, 1929, 4 ser., 18, no. 16, 497-530, pls. 36-41). The material was obtained from shallow oil wells, and was a fine-grained clay shale, grey in colour and containing poorly-preserved Upper Cretaceous fossils, such as *Inoceramus* and *Baculites*. On breaking down the shale, a well-preserved fauna

of small foraminifera was obtained, entirely new to Californian palæontology. They represent species widely distributed in Upper Cretaceous seas, and a large proportion are identical with those described from Central Europe. Many of them are also present in the Upper Cretaceous of Texas and the Gulf coastal region, but a comparison of the two faunas shows the presence of pelagic forms in the eastern area which are absent from the Californian collections. It may be inferred that the Californian material represents an area cut off from the main Cretaceous ocean, into which pelagic forms were not carried to any great extent. The most abundant species represents a new genus, *Silicosigmoilina*, a siliceous isomorph of *Sigmoilina*, and closely related to *Rzehakina*, another siliceous genus characteristic of the Upper Cretaceous of Trinidad. Five new species in all are described. The paper is well illustrated. A. E.

Observations on Some Freshwater Ciliates.—D. M. WENRICH ("Observations on Some Freshwater Ciliates (Protozoa). I. *Teuthophrys trisulca*, Chatton and de Beauchamp and *Stokesia vernalis*. n.g., n.s.p.," *Trans. Am. Micr. Soc.*, 1929, 48, 221–37, 2 pls.). A freshwater ciliate, first described by Chatton and de Beauchamp from a lake in the Vosges Mountains, is recorded from the botanical gardens of the University of Pennsylvania. The same ciliate is probably an inhabitant of the Cape of Good Hope and Central Australia. A new ciliate, *Stokesia vernalis*, was found in a pond in Philadelphia in 1924, and is here described. It is placed in the family Chiliferidæ, of the sub-order Trichostomina of the order Holotrichida. G. M. F.

The Oxymonad Flagellates of Termites.—H. KIRBY, Jr. ("A Species of *Proboscidiella* from *Kaloterms* (*Cryptoterms*) *dudleyi* Banns, a Termite of Central America, with Remarks on the Oxymonad Flagellates," *Q. J. Micro. Sci.*, 1928, 72, 354–86, 4 pls.). *Proboscidiella kofoidi* sp. n., parasitic in the intestine of a termite, *Kaloterms* (*Cryptoterms*) *dudleyi*, from Panama Canal zone, is described. It differs from the generic type in absence of a blepharoplast bar, but has two blepharoplasts, possibly connected by a filament, and two pairs of long flagella in each mastigont. The number of mastigonts varies from 2 to 19, with an average of 8. Average size of the flagellate, 66 by 46 μ , rostellum about as long as the body. A detailed description and illustration of the morphology and division are given. A new family, Oxymonadidæ, is created to include the following genera: (?) *Microrhopulodina*, *Oxymonas*, *Proboscidiella*. The Oxymonadidæ are characterised as follows: entozoic flagellates which have a rostellum, a characteristic nucleus, and a peculiar type of mitosis. The nucleus contains a large karyosome and granular chromatin filling the remaining space. During division, a stout centrodosome, apparently developed from the karyosome, is formed. Each mastigont has two blepharoplasts, from each of which a group of flagella arise, an axostyle, probably a parabasal, and cytoplasmic and rostellar filaments. Majority of known species are uninucleate, but there are also multinucleate forms of some of these species and multinucleate species. A list of termites in which oxymonad flagellates have been found is appended. C. A. H.

New Species of Devescovina from India.—F. de MELLO and J. de BRITO ("Sur trois espèces de *Devescovina* parasites de l'intestin d'un termite recolté à Damaum (Inde Portugaise) et de la complexité de leur appareil kinétoplastique," *Arg. Escola Méd.-Cirurg. Nova Goa*, 1929, A. 5, 693–706, 2 pls.). A description of three new species of *Devescovina* from the intestine of *Coptotermes heimi*, Portuguese India. *D. damanensis* sp. n.: length 6–70 μ (majority measure 24–38 μ), breadth 6–45 μ , trailing flagellum 40–120 μ , anterior flagella 25 μ .

D. cometoides sp. n.: length 30–100 μ (in majority 40–64 μ), breadth 6–26 μ , trailing flagellum 45–80 μ , anterior flagella 25–30 μ . *D. kirbyi* sp. n.: length with axostyle 12–88 μ (in majority 15–25 μ), length without axostyle 7–55 μ , breadth 3–16 μ , trailing flagellum 30–90 μ , anterior flagella 20–25 μ . A review of other species is given. C. A. H.

A New Genus of Calonymphidæ.—F. de MELLO and J. de BRITO (" *Metastephanonympha perronciti* n. gen., n. sp., calonymphide d'un termite de Damão," *Arq. Escola Méd.-Cirurg. Nova Goa*, 1929, A. 5, 707–11, 1 pl.). Description of a calonymphid flagellate parasitic in the intestine of *Coptotermes heimi*, Portuguese India, *Metastephanonympha perronciti* gen. n., sp. n. The most important characters are as follows: the axostyle is composed of a compact bundle of fine filaments diverging anteriorly and enveloping the posterior nuclei; arriving towards the anterior end of the body, the axostyle filaments intermingle with the flagella. The nuclei (80–100) are arranged in about four rows occupying the anterior third of the body. Each mastigont consists of a nucleus, a nuclear centrosome connected by a rhizoplast with a blepharoplast, from which two flagella are given off. Apart from these, each nucleus is associated with an axostyle filament and a parabasal. The flagellates measure 25–100 μ in length and 20–85 μ in breadth. C. A. H.

The Status of *Mayorella bigemma*.—P. L. JOHNSON (" *Amœba dofleini* (Neresheimer) vs. *Mayorella bigemma* (Schæffer), a Case of Synonymy," *Science*, 1928, 68, 84–5). The original description of *Amœba dofleini* Neresheimer, 1905, agrees in all essential details with the diagnostic characteristics of *Mayorella bigemma*, Schæffer, 1926.(= *A. bigemma*, Schæffer, 1918), which therefore becomes a synonym of Neresheimer's species. C. A. H.

Observations on Leucocytozoa.—F. VOLKMAR (" Observations on *Leucocytozoon smithi*, with Notes on Leucocytozoa in Other Poultry," *J. Parasitol.*, 1929, 16, 1–12, 1 text-fig.). The sexual stage of *Leucocytozoon smithi* from the blood of domestic turkeys is described. It is believed that the parasitised cell is a modified reticulo-endothelial cell. The freed gametocyte is spherical in shape. The characteristic elongated shape of the intracellular parasite is due to pressure of the host cell wall and nucleus. The host cell itself stretches to 4–5 times its normal length, the ends becoming drawn out in the form of a spindle, while its nucleus breaks up. In the macrogametocyte the cytoplasm is alveolar, dense, staining deep violet-blue (Wright's stain), while in the microgametocyte it is less dense and stains pale blue. In the female gamete the nucleus does not stand out as clear as in the male. A table is given of the comparative morphology of various leucocytozoa of poultry as described by different authors. C. A. H.

The Status of *Councilmania*.—L. B. FREEMAN (" Studies on *Amœbæ* from Human Hosts," *J. Parasitol.*, 1929, 16, 1–12, 1 pl.). The author maintains the specific independence of *Councilmania lafleuri* Kofoid and Swezy, 1921. Since, however, the "budding" process upon which the validity of the genus had been based was shown to be an artifact, it is suggested that the correct name for this amœba is *Endamœba lafleuri*. C. A. H.

New Myxosporidia.—A. P. JAMESON (" Myxosporidia from Californian Fishes," *J. Parasitol.*, 1929, 16, 59–68, 1 pl.). The author describes the myxosporidia found by him in fishes from Monterey Bay, California. In all, 230 specimens were examined, belonging to 36 different species. Of these, 27 were found to be infected with myxosporidia. There were found 16 different species of these

sporozoa, all belonging to known genera, 12 of them being new species. It is emphasised that the structure of the nucleus forms an important feature in the identification of protozoa, and this has been considered in the present work. The new parasites are as follows: *Ceratomyxa californica*, *galeata*, *fisheri*, *gracilis*, *inconstans*, *starksi*, *elegans*, *obesa*, *crassa*, *hopkinsi* spp. n., *Chloromyxum ovatum* sp. n., *Sphaeromyxa reinhardti* sp. n. A brief description of each of these is given.

C. A. H.

Observations on Human Amœbiasis.—W. M. JAMES ("Some Observations of Intestinal Amœbiasis, due to Infection with *Entamœba histolytica*," *Ann. Intern. Med.*, 1928, **2**, 171-6). ("Human Amœbiasis, Due to Infection with *Entamœba histolytica*," *Ann. Trop. Med. & Parasit.*, 1928, **22**, 201-58, 17 pls.). In these papers, both covering the same ground, the author deals mainly with the question of so-called "latent *histolytica* infections," or "intestinal amœbiasis," as distinguished from the typical "amœbic dysentery." Infection with *Entamœba histolytica* is held to be responsible for a large proportion of obscure gastro-intestinal trouble which is not manifested by dysentery. Apparently the parasite attacks the host-tissues only at rare intervals, living harmlessly in the lumen of the gut the rest of the time, or it normally produces such minute lesions in the colon that they are rapidly healed. A detailed description of the lesions and various technical suggestions for diagnosis are given. The conditions described are illustrated by excellent photomicrographs in 17 plates. C. A. H.

A Trypanosome of the Newt.—R. F. NIGRELLI ("On the Cytology and Life-History of *Trypanosoma diemyctyli* and the Polynuclear Count of Infected Newts (*Triturus viridescens*)," *Trans. Am. Micr. Soc.*, 1929, **48**, 366-87, 2 pls.). The blood of *Triturus viridescens* is infected with two forms of *Trypanosoma diemyctyli*—(a) long slender forms, and (b) large broad forms. The vertebrate cycle of the trypanosome shows reproduction by binary fission and by the production of leishmania-bodies in endothelial leucocytes, and possibly in the liver and spleen of the host. In the invertebrate cycle it has been found that development may take place in the leech, *Placobdella parasitica*, although the true intermediate host is not known. The cytology of the organism is described. Trypanosomiasis of the newt causes a left-hand deflection of the polymorphonuclear count, indicating that the granulocytopoietic centre is stimulated: the peripheral blood system is flooded with young neutrophils.

G. M. F.

New Freshwater Ciliates.—D. H. WENRICH ("Observations on Some Freshwater Ciliates (Protozoa). II. *Paradileptus* n. gen.," *Trans. Am. Micr. Soc.*, 1929, **48**, 352-65, 2 pls.). The new genus *Paradileptus* is characterised by similarity to *Dileptus*, but differs in having a broader body at the level of the cytostome, producing a wide peristomal field which bears the cytostome and is surrounded for about two-thirds or three-quarters of its circumference by a raised rim which is continuous anteriorly with the spirally wound proboscis; trichocyst zone traversing the rim and the anterior edge of the proboscis; contractile vacuoles small, numerous, distributed over the body; macronucleus segmented. *P. flagellatus* (= *Amphileptus flagellatus* Rousselet 1890) is co-generic with the new species here described, and is designated as the type species. *P. conicus* is usually 100 to 200 μ long, *P. robustus* between 200 and 350 μ long.

G. M. F.

The Cytology of Certain Euglenoid Flagellates.—L. H. HYMAN ("On the Comparative Cytology of Certain Euglenoid Flagellates and the Systematic Position of the Families *Euglenidæ* Stein and *Astasiidæ* Bütschli," *Trans. Am. Micr.*

Soc., 1929, 48, 388-405, 3 pls.). It is here shown that in various species of *Phacus*, *Euglena*, *Trachelomonas* and *Lepocinclis*, vegetative stages are characterised by a basal bifurcation of the flagellum into rami which end in separate blepharoplasts, and by a "flagellar swelling" at the level of the stigma. Such structural features of the flagellum were not observed in non-chlorophyll-bearing euglenoids (*Astasiidæ*). On the basis of such structural differences it is concluded that there is no justification for combining the families *Euglenidæ* Stein and *Astasiidæ* Bütschli into a single family "*Euglenidæ*."

G. M. F.

A Trichomonas of the Porcupine.—R. KNOWLES and B. M. DAS GUPTA ("A Note on a *Trichomonas* of the Porcupine," *Ind. J. Med. Res.*, 1929, 16, 653-5, 1 pl.). The parasite was found in small numbers in the cæcal contents of a porcupine. The body, measured along the axostyle, varied from 18 to 26 μ , the breadth from 6 to 14 μ , the anterior flagella from 8 to 25 μ , and the posterior flagellum, measured along the edge of the undulating membrane and beyond to the tip, 24 to 45 μ . No cysts were found either in the cæcal contents or in the culture.

G. M. F.

A Piroplasma seen in Poultry in Egypt.—M. CARPANO ("Su di un piroplasma osservato nei polli in Egitto (*Aegyptianella pullorum*) Nota preventiva," *Clinica Vet.*, 1929, 52, 339-51, 3 pls.). There has frequently been observed in the blood of native poultry in Egypt an occasional anaplasma-like body. Examination of the blood of Sussex and Rhode Island Red poultry which had become seriously ill a few days after importation revealed the presence of intracorpuscular parasites bearing a resemblance to piroplasms. In fresh films the parasites could be detected as refractile bodies which were capable of executing slow movements of translation within the red cells. After staining with Giemsa, the parasites, the majority of which were intracorpuscular, were found to vary from 1 to 3 or 4 μ . The majority were rounded, though some were club-shaped. The smallest forms comprised a nuclear granule of chromatin with a very small amount of cytoplasm. Larger parasites varied in shape, being oval, round, or even polygonal. In particularly well-stained parasites a principle nuclear mass and a smaller accessory piece of chromatin could be detected, while in some there was a central vacuole. In still larger forms the chromatin was frequently arranged in the form of an incomplete ring or in the form of a number of separate granules. Reproduction is by schizogony; the usual number of merozoites is 12. Ten p.c. of corpuscles may be invaded; and sometimes as many as six parasites have been found in the same red cell. Experimental inoculation results in the appearance in the blood corpuscles of anaplasma-like bodies about the tenth day. A new genus, *Aegyptianella*, is created, while the parasite is given the name *Aegyptianella pullorum*.

G. M. F.

A Leishmania-like Phase in the Development of *T. vivax-cazalboni* and *T. congolense-dimorphon* in the Vertebrate Host (bovines).—J. SCHWETZ ("Un stade leishmaniaoïde dans l'évolution du *T. vivax-cazalboni* et du *T. congolense-dimorphon* chez l'hôte vertébré (bovidés), Note préliminaire," *Ann. Soc. belge Méd. trop.*, 1928, 8, 315). The morphological relationships between *Leishmania* and flagellates is very close, but so far only two of the flagellates proper are known to have a leishmania stage—namely, *Schizotrypanum cruzi* and *T. vespertilionis*. *T. inopinatum* sometimes assumes a form strikingly like *Leishmania*. The author here describes infections with *T. congolense* and *T. vivax* in cattle, where in the heart blood there were deformed parasites closely resembling leishmania.

G. M. F.

A Tricercomonas of the Pig.—R. KNOWLES and B. M. DAS GUPTA (*Ind. J. Med. Res.*, 1929, **16**, 647–52, 2 pls.). The organism was found in large numbers in the caecal contents of a pig, and was successfully grown in Row's hæmoglobin-saline medium and on subculture in a modified Bœck and Drbohlav medium. In shape it resembles a broad ovate leaf, and measures 10 to 20 μ in length by 7 to 14 μ in breadth. Three flagella arise from the anterior group of basal granules, and these beat slowly in unison. They are slightly shorter than the body, but there is a longer trailing flagellum, arising from the same source, which apparently acts independently. No cysts were found. The organism is given the name of *Tricercomonas suis*. n. sp. G. M. F.

The Existence of "Grenade Bodies" in the Cycle of Development of *Gonderia mutans*.—E. SERGENT, A. DONATIEN, L. PARROT and F. LESTOQUARD ("Sur l'existence de corps en grenade dans le cycle évolutif de *Gonderia mutans*," *Bull. Soc. Path. exot.*, 1929, **22**, 542–4). The authors confirm the findings of Theiler and Graf that in the cycle of development of *Gonderia mutans* schizogonous forms (plasma bodies) occur as in the cycle of *Theileria*. They therefore agree that the genus *Gonderia* should lapse, and that the parasite should become *Theileria mutans*. G. M. F.

The Schizogonous Forms of a Sporozoön of the Guinea-pig.—G. LEDENTU, A. SICE and M. VAUCEL ("Formes schizogoniques d'un sporozoaire du cobaye," *Bull. Soc. Path. exot.*, 1929, **22**, 323–5, 7 text-figs.). The authors here describe and figure bodies found in the blood and liver smears of guinea-pigs. The smaller forms of the organism measured about 10 μ in diameter, and contained two nuclei. Other forms containing large numbers of nuclei ranged up to 20 μ or more in diameter. Vacuolation of the protoplasm was distinct, and in some of the larger forms there was evidence of impending separation of the cytoplasm around the nuclei prior to schizogony. G. M. F.

Intestinal Amœbæ from Various Animals.—R. HEGNER and E. SCHUMAKER ("Some Intestinal Amœbæ and Flagellates from the Chimpanzee, Three-toed Sloth, Sheep and Guinea-pig," *J. Parasitol.*, 1928, **18**, 31–7, 11 text-figs.). Three types of amœbæ were found in the stools of a non-dysenteric chimpanzee which died in the Zoological Gardens at Baltimore. These were cysts resembling *E. histolytica*, *E. coli*, and cysts and trophozoites of a species similar to *Iodamœba williamsi*. In a three-toed sloth (*Bradypus griseus griseus*) a cyst of an endamœba was found with eight nuclei of the histolytica type, though the details of the arrangement of the chromatin differed from that type. The name *E. bradypis* is suggested. The same host harboured trophozoites of *Giardia* resembling those occurring in rabbits and guinea-pigs. G. M. F.

A Study of Sarcosporidia in Korean Cattle.—S. NAKANISHI (*J. Jap. Soc. Vet. Sc.*, 1929, **8**, 119–27). The author believes that there are three kinds of sarcosporidia infecting cattle, which he describes in tabular form under the headings A, B, and C, as he prefers not to use the definite terms "genus" or "species" in his description. Type A is of very rare occurrence. It is rounded or oval in shape, and measures 200–400 μ ; the spores are 7–8 by 2–3 μ . The presence of the parasite causes a marked tissue reaction, which is best seen in the connective tissues of serous and mucous membranes. The cyst membrane is not striated, and has a hyaline lining. Type B is the most usual type. It is elongated in shape, and measures 1,500–2,500 μ by 200–260 μ . The spores are 5–14 μ by 45–6 μ . The presence of the parasite causes little or no tissue reaction. The cyst membrane

has an outer striated layer and an inner hyaline one. The heart and skeletal muscles are the sites of predilection. Emulsions of the parasite are toxic to rabbits. Type C is frequently encountered. It is very long and slender, measuring $4,000-9,000\mu$ in length by $400-900\mu$ in breadth. The spores are also larger than in the other types, and range from $13.3-27.5\mu$ by $4.7-7\mu$. In its other characters it resembles type B.

G. M. F.

Balfour Bodies in the Blood in Poultry.—G. CURASSON and P. ANDRJSKY ("Sur les 'corps de Balfour' du sang de la poule," *Bull. Soc. Path. exot.*, 1929, 22, 316-7). Additional evidence is here brought forward in favour of the view that the intracorpuseular bodies described by Balfour, in 1907, in the blood of fowls are unconnected with fowl spirochætosis. A young dove inoculated intramuscularly with blood containing Balfour bodies showed the characteristic bodies on the fifth day and died suddenly on the seventh day, when very numerous bodies were found in the blood of the lung. In a crested crane, inoculation with infected blood also produced similar bodies.

G. M. F.

Intestinal Amœbiasis in Kittens.—C. W. REES ("Pathogenesis of Intestinal Amœbiasis in Kittens," *Arch. Pathol.*, 1929, 7, 1-26, 10 text-figs.). To find the method by which *Endamœba histolytica* attacks the tissues of the colon to produce dysentery, 84 kittens were used, nearly all weighing 400 to 700 gm. Experiments were impracticable during the winter months, because pneumonia and bacillary dysentery were common in the kittens at this time of year and environmental conditions were unfavourable. Even with the more favourable conditions of April, May, and June, the problem may have been complicated by bacteria, alone or in conjunction with amœbæ. The amœbæ were grown in Boeck and Drbohlav's egg slant serum medium and were injected into the kittens through the wall of the ligated colon following laparotomy, and through the anus into the unobstructed bowel. Infection followed much more frequently when fæces from infected kittens were used than with pure cultures of amœbæ. The kittens were killed 12-140 hours after laparotomy and 3-50 days after rectal injection. Lesions could not be detected sooner than 40 hours after laparotomy. Within 90 hours the mucosa was usually necrotic, constituting a diphtheritic membrane. Ulcers were present in all kittens which became infected after rectal injection. Uninfected colons remained normal up to 90 hours after laparotomy, and indefinitely after rectal injection. The colon tissues were fixed immediately after death to prevent post-mortem penetration by the amœbæ. This was more rapid than during life, due, no doubt, to the breakdown of resistance and the autolytic softening of the tissues. The lesions of the living and fixed colons were studied under the binocular microscope. The earliest ulcers appeared as hyperæmic areas. Amœbæ from them were gorged with red blood cells, and appeared to have caused the bleeding. The first symptom of intestinal amœbiasis was diarrhœa, and sections of the colon showed widely-open crypts and prominent goblet cells. Multiplication of the amœbæ occurred in the lesions and probably within the fæcal content. The attack began on the epithelial cells most exposed to the fæcal content and near the ileocæcal valve. Hypersecretion of the glands appeared to retard invasion of the crypts. There was definite anatomical evidence that the host reaction killed some of the parasites. In all lesions a zone of necrosis separated the amœbæ from the living cells, indicating the action of a cytolytic substance, but without proof that the latter was excreted by the amœbæ. Out-wandering of leucocytes into the necrotic area indicated a host response to bacterial activity. Camera-lucida drawings of lesions earlier than those heretofore figured indicate that the method of producing ulcers is different from that usually described.

G. M. F.

Trypanosomiasis of Camels in Cyrenaica.—G. FRANCHINI and A. CADEDU ("Su di una tripanosomiasi dei cammelli a Giarabub in Cirenaica," *Arch. Ital. Sci. Med. Colon.* 1927, 8, 3-5). The trypanosomes of the camel discovered by Franchini (1926) have been inoculated into guinea-pig and mole. In the former the dimensions become somewhat greater than in the camel. The morphology of the trypanosome differs from that of all others, and in part from that of *Trypanosoma evansi*. By clinical symptoms it cannot be distinguished from "Surra." It may be recorded as var. "*mboi*," existing in the Sudan, whence come the camels of Giarabub. The tick *Hyalomma dromedari* and several culicids are under suspicion as the insect vectors. *Biological Abstracts.*

A Neurotropic Strain of Trypanosoma cruzi.—E. DE S. CAMPOS ("Estudos sobre uma raça neurotópica de *T. cruzi*," *Ann. Fac. Med. São Paulo*, 1927, 2, 197-201, 5 pls.). Adult dogs inoculated with a neurotropic strain of *T. cruzi* obtained from an armadillo (*Tatus novemcinctus*) showed nervous phenomena, and focal inflammatory lesions containing parasites in the spinal cord. Dogs and other small animals were inoculated with the same strain maintained for about one year by transfers on blood agar every 12 to 15 days, in order to determine whether this apparent electivity for nervous tissue was a fixed character of the parasites persisting after prolonged cultivation *in vitro*. Circulating blood after 10 to 15 days showed flagellated parasites. The animals developed paraplegia in 25 to 30 days. The tendency to nervous system involvement was in no way modified by prolonged cultivation. Similar results were obtained with the same strain from *Triatoma megista*, the insect carrier, infected by feeding on inoculated animals. *Biological Abstracts.*

The Gametocytes of Tertian Malaria and their Early Appearance in Malaria transmitted by Anopheles punctipennis.—J. H. ST. JOHN (*Am. J. Trop. Med.*, 1928, 8, 305-23, 1 pl.). Cases (11) of tertian malaria in paretics were studied for 20 days. Daily counts were made (on 600 microscopic fields per case), and the ratio of asexual to sexual forms computed. The average ratio of schizonts to macrogametocytes was 29:1, of schizonts to microgametocytes 99:1, of schizonts to all gametocytes 22:1, and of ♀ to ♂ gametocytes 3.4:1. *A. punctipennis* was used to test gametocyte presence in early stages of infection. This species proved to be an efficient experimental vector of *Plasmodium vivax*. Mosquitoes were infected from mosquito-induced cases as early as the fourth day following infection onset. It is therefore necessary to screen tertian cases from the beginning of infection. *Biological Abstracts.*

Pre- and Meta-palintomic Metamorphoses in the Fœttingeridæ (Ciliates).—E. CHATTON, M. LWOFF and A. LWOFF ("Les métamorphoses prépalintomiques et métapalintomiques des Fœttingeridæ (Ciliés)," *Compt. rend. Acad. des Sc.*, 1929, 188, 273-5). At the moment of encystment the helicoidal ciliation of vegetative individuals disappears, the cilia are detached from the body and remain in the mucous wall of the cyst. Later, in the encysted stage, the ciliary bands show a meridional instead of a helicoidal course. This meridional plan lasts during multiplication in the cyst, after which the meridional ciliary system becomes changed again to a helicoidal one. In *Spirophrya* and *Gymnodinioides* the phase without cilia lasts only 24 to 72 hours. In *Synophrya hypertrophica*, which encysts under the skin of crabs, multiplication can occur only during moults, periods several months apart in adult crabs. Fixation of the organisms through the cyst wall was accomplished. The helicoidal system is present as encystment takes place, but, as cysts

become older, is gradually changed to a meridional system. Multiplication within the cyst takes place only after this change is affected. The first fission is at right angles to the long axis, and division is linear, as in all the Fœttingeridæ. In *Polyspira delagei*, the only member of this group which undergoes this metamorphosis without encystment, there is only a slight untwisting before multiplication. The occurrence of the meridional system of ciliation and the two metamorphoses seem to be connected with multiplication in the cyst. *Biological Abstracts.*

Agglomeration of Trypanosomes without Blepharoplasts.—O. JIROVEC ("Über die Agglomeration von blepharoplastlosen Trypanosomen," *Arch. f. Protistenk.*, 1928, **64**, 457-61, 1 pl.). Prowazek and Schindera were of opinion that the blepharoplasts of trypanosomes and trypanoplasms, in their agglomeration, cause the stickiness of their surface, and thereby make the agglomeration possible. The agglomeration of *Trypanosoma evansi*, however, which was deprived of the blepharoplast by trypanflavin, took place just as in normal control trypanosomes. The blepharoplast, therefore, plays no rôle in trypanosome agglomeration.

Biological Abstracts.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Chromosome Ring in *Pisum*.—E. RICHARDSON ("A Chromosome Ring in *Pisum*," *Nature*, 1929, Oct. 12). Sterility affecting about 50 p.c. of the ovules and pollen-grains occurs amongst descendants of certain crosses in *Pisum*. In one such plant examined, a ring of four chromosomes was found to occur regularly at the heterotypic division of the pollen mother-cells. It is suggested that if two homologous chromosomes of this ring go to each pole, non-viable gametes result, whereas viable gametes would be formed after normal separation of homologues. If these methods of separation occur with equal frequency, this ring formation may account for the 50 p.c. sterility observed. J. L.

Chromosome Numbers in *Potentilla*.—NAOMASA SHIMOTOMAI ("Über die Chromosomenzahlen bei einigen *Potentilla*en," *Science Reports, Tôhoku Imp. Univ.*, 1929, 4, 369-71). The chromosome numbers are given for the following species of *Potentilla* native to Japan: *P. chinensis* $n = 7$, *P. fragarioides* $2n = 14$, *P. Kleiniana* $2n = 14$, *P. Matsumurae* $2n = 28$, *P. nipponica* $2n = 28$. Polyploidy is thus exhibited with the fundamental number 7. It is considered probable that all the *Potentilloideæ* will be found to exhibit similar polyploid conditions with 7 as the basic number. J. L.

Chromosomes of Dioecious Angiosperms.—RUTH H. LINDSAY ("The Chromosomes of Some Dioecious Angiosperms," *Proc. Nat. Acad. Sci.*, 1929, 15, 611-13). Meiosis has been studied in the pollen mother-cells of *Bryonia dioica*, *Clematis virginiana*, *Smilax herbacea*, *Menispermum canadense* and *Lychnis alba*. Heterochromosomes are found only in *Lychnis alba*. The haploid chromosome numbers are given for the other forms as follows: *Bryonia* $n = 10$, *Clematis* $n = 8$, *Smilax* $n = 13$, and *Menispermum* $n = 26$. In these there is no evidence of an unequal pair of chromosomes which might be correlated with the dioecious condition. J. L.

Chromosome Structure.—W. RANDOLPH TAYLOR ("Chromosome Structure in Mitosis and Meiosis," *Proc. International Congress Plant Sciences*, 1929, 1, 265-70). The features which give chromosomes their characteristic form are size, position of attachment to the spindle fibre which is marked by a constriction, constrictions unrelated to spindle attachment, and satellites. In *Gasteria* chromosome tetrads can be demonstrated. It is probable that the tetrad structure will be demonstrable as early as strepsinema. J. L.

Meiosis in *Crepis*.—E. B. BABCOCK and J. CLAUSEN ("Meiosis in Two Species and Three Hybrids of *Crepis*, and its Bearing on Taxonomic Relationship," *Univ. Calif. Pub. Agric. Sci.*, 1929, 2, 401-32). Cytological investigation of the

pollen mother-cells has been made of the two pure species *Crepis aspera* and *C. bursifolia*, together with the three hybrids *C. aspera* \times *C. bursifolia*, *C. tararacifolia* \times *C. tectorum*, and *C. aspera* \times *C. aculeata*. The methods of fixing and staining the material are described in detail. The haploid number of chromosomes in all five species used is $n = 4$. In meiosis in *C. aspera* and *C. bursifolia* the chromonema thread shows chromomeres in the early zygo phase, and the mode of pairing is clearly parasyndetic. The spiral structure of the chromosomes is clearly seen in diplot phase, and in diakinesis this spiral chromonema appears to be doubled by splitting. Chiasmata between the two members of a bivalent pair are frequently seen. These are considered to be the result of an interchange at an earlier stage previous to the shortening of the chromosomes by the coiling of the chromonema. Separation of these crossed-over chromatids would occur at heterotypic anaphase. In *C. bursifolia* one chromosome pair is shorter than the other three, and can be recognised at every phase. In the hybrid *C. aspera* \times *C. bursifolia* the chromosomes can be recognised as similar to those of the parent species. Chiasmata occur between the members of the bivalent chromosomes. The affinity between the chromosomes is not strong, and the amount of pairing varies from 4.0 gemini. The hybrid is almost completely sterile. Meiosis in the hybrid *C. tararacifolia* \times *C. tectorum* is, in the main, similar to *C. aspera* \times *C. bursifolia*, but the parental chromosomes are not distinguishable. The meiotic behaviour of *C. aspera* \times *C. aculeata* is far more regular and the hybrid fairly fertile. The occurrence of meiotic irregularities in these hybrids agrees with the taxonomic relations between the parental species. J. L.

Triploidy in *Crepis*.—M. NAVASHIN ("Studies on Polyploidy. I. Cytological Investigations on Triploidy in *Crepis*," *Univ. Calif. Pub. Agric. Sci.*, 1929, **2**, 377–400). Triploid individuals occur in populations of *Crepis capillaris*, *C. tectorum*, and *C. dioscoridis*. These individuals are somewhat larger than normal diploids, and show greatly reduced fertility. The chromosomes of the triploids are exactly similar in size and shape to those of the diploids. Cytological investigations have been made of plants of the first and second generations obtained from the original triploid *C. capillaris*. In F_2 92.7 p.c. of all the progeny of triploids consists of diploids and triploids, 7.3 p.c. of simple and double trisomics, triploid tetrasomics and higher grades of polyploidy, viz., $4n$ and $7n$. Five of the six possible trisomic types of *C. capillaris* are known. These differ morphologically from one another. In the progeny of *C. tectorum* triploids, trisomics occur in the majority and diploids and triploids in the minority, while in the progeny of the *C. dioscoridis* triploids the majority are diploid and only a small percentage are trisomics and triploids. The triploid condition in the female parent is favourable for interspecific hybridisation in *Crepis*. Certain hybrids have been obtained which could not formerly be secured by crossing normal diploid plants. Many such hybrids are polyploid. Triploids may thus play an important part in species formation under natural conditions. Triploidy in *Crepis* probably arose through the formation of a diploid female gamete. The occurrence of triploid, tetraploid, and possibly pentaploid and hexaploid eggs has been proved. These polyploid gametes are viable and capable of fertilisation. J. L.

Genetics and Cytology of a Dwarf Wheat.—W. P. THOMPSON ("The Genetics and Cytology of a Dwarf Wheat," *Trans. Roy. Soc. Canada*, 1928, **22**, 335–48). Crosses made between varieties Pusa 12 and Chul of the *vulgare* wheats result in an F_1 which consists entirely of dwarf plants. In the F_2 a large proportion of tall plants occurs. This is probably due to the large amount of sterility and

low percentage of germination of seed of the F_1 . Half the number of F_2 dwarfs are completely sterile. The others mostly give a progeny which includes tall; a few breed true to dwarf. More than a quarter of the F_2 tall give a few dwarfs. A dwarf plant may occasionally appear in an F_3 family which is otherwise true-breeding for tall, and an occasional tall plant may appear in a dwarf family. A hypothesis involving a factor for dwarfness and an inhibiting factor which is in turn inhibited by a third factor accounts satisfactorily for the results in F_1 and F_2 , and for the proportions of uniform and segregating families in F_3 . Certain plants have been examined cytologically. Meiosis in the parents is regular, and the haploid number for each is 21. In F_1 20-30 p.c. of the pollen mother-cells show one or two lagging univalent chromosomes due to the failure of one pair to mate or to abnormal mating between two pairs. These chromosome irregularities are presumably responsible for the unexpected plants and abnormal ratios.

J. L.

Chromosome Numbers in Wheat Hybrids.—W. P. THOMPSON and D. R. CAMERON ("Chromosome Numbers in Functioning Germ Cells of Species-Hybrids in Wheat," *Genetics*, 1928, **13**, 456-69). The cytological conditions reported for hybrids between 14 and 21 chromosome wheats have been investigated by back-crossing the F_1 s to both 14 and 21 chromosome parents. It is thus possible to determine the chromosome numbers of the F_1 gametes which are capable of functioning. The gametes with numbers of extra *vulgare* chromosomes between 0 and 7 were in much smaller proportion than were to be expected if all gametes were capable of functioning. The gametes with 14 chromosomes (i.e., no extra univalents) were more numerous than those with 21 chromosomes (i.e., 7 extra univalents). The male gametes with intermediate numbers are eliminated in greater proportions than are the female gametes with the same numbers. The endosperm is well developed only when it is without any extra 7 *vulgare* chromosomes, or when it has 2 or 3 complete sets of the extra *vulgare* chromosomes. Reciprocal crosses may therefore give very different results.

J. L.

Meiosis in the Gramineæ.—G. L. CHURCH ("Meiotic Phenomena in Certain Gramineæ. I. Festuceæ, Aveneæ, Agrostideæ, Chlorideæ and Phalarideæ," *Bot. Gaz.*, 1929, **87**, 608-29). The following chromosome numbers are given for the species investigated: *Alopecurus geniculatus* var. *aristulatus*, *Phalaris arundinacea* $n = 7$; *Phalaris canariensis* $n = 6$; *Dactylis glomerata*, *Ammophila breviligulata*, *Alopecurus pratensis*, *Spartina Michauxiana*, *Phalaris arundinacea* var. *picta* $n = 14$; *Festuca rubra*, *F. duriuscula*, *Avena sativa* var. *mutica*, $n = 21$, *Spartina alterniflora* var. *glabra* $2n = 42$ forming 14 bivalents and 14 univalents at reduction, *Festuca ovina* $n = 28$. Meiotic irregularities, such as lagging and extrusion of chromosomes, cytomyxis, polycary and the production of sterile pollen, are found in all species except *Phalaris arundinacea*. Lagging univalents are found in *Spartina alterniflora* var. *glabra*. These cytological abnormalities and the polyploid condition are taken as evidence of the hybrid origin of the species exhibiting them. No cases of polyspory are found. *Phalaris arundinacea* shows meiotic divisions, tetrads and pollen which are normal in every respect, and it is considered a pure diploid species.

J. L.

Meiosis in the Gramineæ.—G. L. CHURCH ("Meiotic Phenomena in Certain Gramineæ. II. Paniceæ and Andropogoneæ," *Bot. Gaz.*, 1929, **88**, 63-84). The following chromosome numbers are given for the species investigated: *Paspalum Muhlenbergii* $n = 10$, *Panicum Lindheimeri* vars. *subvillosum*, *tsugetorum*, *sphaerocarpon*, *Scribnerianum* $n = 9$, *Digitaria sanguinalis* $n = 14$, *Panicum*

miliaceum, *Sorghastrum nutans* $n = 20$, *Panicum dichotomiflorum* $n = 27$, *Echinochloa Crus-galli*, *Miscanthus sinensis* var. *zebrinus* $n = 21$, *Echinochloa frumentacea* $n = 28$, *Andropogon scoparius* $2n = 56$ forming 21 bivalents and 14 univalents at reduction, *A. furcatus* $n = 35$. The grasses thus exhibit polyploidy with 7, 8 or 9 as the basic haploid number. Dysploidy is observed in various genera and species. The species investigated display meiotic irregularities of the usual type, including the lagging of univalents in *Andropogon scoparius*, non-disjunction in *Panicum Lindheimeri* var. *fasciculatum* and polyspory in var. *typicum*. The species investigated are considered to have arisen by hybridisation because of the evidence of polyploidy and the abnormal cytological behaviour. J. L.

Golgi Apparatus in Vicia.—F. M. SCOTT ("The Occurrence of Golgi Apparatus in the Seedling of *Vicia Faba*," *Am. Journ. Bot.*, 1929, 16, 598-605). Observations are made on root-tips of *Vicia Faba* fixed in Bensley's fixative for forty-eight hours and eight days respectively. In the material fixed for the shorter period, a reticulate canal system is present in the meristematic cells, the canals appearing colourless. After fixation for eight days a typical blackened Golgi reticulum is present. The blackening of the osmic acid indicates the presence of lipoids, fats and proteins, and the Golgi may thus be considered as a food reserve in the meristematic tissues. The Golgi apparatus is abundant in the cells of the periblem and dermatogen, but absent from the plerome. With the appearance of the secondary roots there is a temporary change in the distribution of the Golgi apparatus, which disappears from the primary root to reappear when the secondary roots are about 1 cm. in length. A colourless canal system remains in the primary root meristematic cells when the Golgi apparatus is absent. The maintenance of a canalicular system is thus independent of the presence of reserve materials. This system may be called the vacuome or Golgi apparatus according to its contents and appearance in non-osmicated or osmicated sections. The accumulation of water from the condensation of amino acids during protein synthesis is suggested as a possible origin of the vacuome or Golgi apparatus. J. L.

A Tetraploid Psilotum.—SAKUICHI OKABE ("Über eine tetraploide Gartenrasse von *Psilotum nudum* Palisot de Beauvois (= *P. triquetrum* Sw.) und die tripolige Kernteilung in ihren Sporenmutterzellen," *Science Reports, Tôhoku Imp. Univ.*, 1929, 4, 373-9). The haploid chromosome number for *Psilotum nudum* is 52. A tetraploid race has been found with 104 gemini clearly present at diakinesis. In the first metaphase of the spore mother-cells of the tetraploid a tripolar spindle is formed in nearly 80 p.c. of the cases observed. After the homotypic division hexads are most frequently formed, though other numbers from 4-10 also occur. The spores from the tetraploid race are as fertile as those from the diploid. J. L.

The Effect of pH on Fixation Images.—C. ZIRKLE ("The Effect of Hydrogen-Ion Concentration upon the Fixation Image of Various Salts of Chromium," *Protoplasma*, 1928, 4, 201-27). The fixation images of chromic acid and of many salts of chromium are described. The image of chromic acid is as follows: in resting cells the nucleolus is a dark-staining globule in the centre of a hollow nucleus whose periphery is composed of the chromatin reticulum. The mitochondria are not preserved, and the cytoplasm is disorganised. In division stages the chromosomes and spindle fibres are well fixed. The fixation image of a bichromate depends on its pH value. If the solution is more acid than a given critical point, the image is like that of chromic acid; if on the alkaline side of the critical point, the image is different. In the resting nucleus the nucleolus appears

in a solid nucleus composed of fixed nuclear lymph. The chromatin and spindle fibres are dissolved, and the mitochondria and cytoplasm are well fixed. The point of change from "acid" to "basic" image ranges from pH 4.2-5.2 among the bichromates investigated. The change from one image to another is, as a rule, sudden and complete for any one salt. After this change has taken place, further change in pH has little effect upon the image. The form of mitochondria depends upon the cation of the bichromate as well as on the pH. J. L.

Fixation Images.—C. ZIRKLE ("Fixation Images with Chromates and Acetates," *Protoplasma*, 1929, 5, 511-34). The fixation images of several bichromates are described. An "acid" image is given by a solution on the acid side of the critical point (pH 4.2-5.2 for the bichromates investigated) and a "basic" image by those more alkaline. With certain bichromates the two images overlap. Certain bichromates give "acid" images only. With the twenty acetates investigated, the basic fixation image is never formed. Below pH 4 the "acid" image differs from that of the bichromate in the appearance of the nucleoli. The acetates never preserve mitochondria. When mixed with other reagents, the acetates usually set the image because of their rapid penetration. When fixed with acetates alone, material is greatly shrunk by the subsequent processes of the paraffin technique. The individual metallic elements of the salts have a much greater influence upon the acetate fixation image than upon that of the bichromate. Explanations are suggested to account for the appearances obtained in these investigations. J. L.

Anatomy.

Growth Rings in Australian Araucarians.—W. D. FRANCIS ("Growth Rings in the Wood of Australian Araucarian Conifers," *Proc. Linn. Soc., N.S.W.*, 1928, 53, 71-9, 2 pls.). Sections of stems of the hoop-pine (*Araucaria Cunninghamii*), bunya pine (*Araucaria Bidwilli*), and Queensland kauri pine (*Agathis robusta*) were examined. The material was from trees growing under subtropical climatic conditions. The growth rings consist of a light-coloured and a dark-coloured zone, presumably corresponding to spring wood and summer wood respectively. The transition is generally gradual. The rings are not so distinct or regular as those of north temperate trees. It appears highly probable that two, three, or even more rings may be added to the woody cylinder in one year. Instances may also occur in which rings are omitted or are only imperfectly defined. On the other hand, there is evidence to show that in the hoop-pine the rings are expressive of annual periods. The rings in the wood of young fast-growing trees are frequently more readily discernible to the naked eye than by microscopic examination. This does not apply so strongly in the case of mature wood. The tracheids of the outer portion of the ring are comparatively thick-walled and have their radial dimensions reduced. They also show bordered pits in their tangential walls; these are much more frequent in the Queensland kauri pine than in the two species of *Araucaria*. In all cases they are smaller than the bordered pits in the radial walls. B. J. R.

Vegetative Anatomy of *Gmelina Leichhardtii*.—W. D. FRANCIS ("Features of the Vegetative Anatomy of the Australian White Beech *Gmelina Leichhardtii*," *Proc. Linn. Soc., N.S. Wales*, 1928, 53, 474-84, 3 pls., 9 figs.). The structure of the hairs investing the young shoots, branchlets, petioles and under side of the leaves is described. A peculiar form of four-limbed gland occurs on the under side of the leaves. A discontinuous ring of hardened bast-fibres occurs in the branchlets and secondary roots. Groups of lignified parenchyma cells constitute the sclerenchymatous elements of the bark of large trees. The

structure of the wood is described. A white substance termed gmelinol occurs in the vessels and rays of the wood. Crystals of hesperidin are widely distributed in different organs. Xerophytic characters are lacking in the leaves. The appearance and structure of the bark are described and the means by which the bark is shed are outlined. In vegetative characters generally the species resembles other representatives of the family Verbenaceæ.

B. J. R.

Wood Structure of the Euphorbiaceæ.—H. H. JANSSONIUS ("A Contribution to the Natural Classification of the Euphorbiaceæ," *Trop. Woods*, 1929, **19**, 8–10). The Javanese trees of the Euphorbiaceæ belong to the tribes Phyllanthæ and Crotonæ of Bentham and Hooker. In the first tribe the wood-structure of the genera *Aporosa*, *Baccaurea*, *Cyclostemon* and *Putranjiva* indicates that they form a natural group quite distinct from the other Phyllanthæ. The wood-structure of *Daphniphyllum* is so different from other Euphorbiaceæ that it is doubtful whether it should be included in the family. Its affinities are rather with a large group of families, which includes the Ternstroemiaceæ and the Hamamelidaceæ. The genus *Acalypha*, on anatomical grounds, should be included in the Phyllanthæ rather than the Crotonæ.

B. J. R.

Microchemical Reactions of Woody Tissues.—W. M. HARLOW ("Contributions to the Chemistry of the Plant Cell Wall. III. The Reliability of Staining Reagents in Microchemical Studies of Plant Cell Walls. IV. Some Microchemical Reactions of Woody Tissues Previously Treated with Hydrofluoric Acid," *New York State Coll. Forestry*, 1928, *Tech. Pub.*, **26**, 1–22, 4 pls.). The paper deals experimentally with the efficacy of stains used in histological work in interpreting the chemistry of plant tissues. The effect of certain stains upon wood cellulose and lignin, and the action, selective or otherwise, of these reagents upon thin transverse sections of untreated wood, was critically observed. Cellulose was prepared from the wood of *Pinus ponderosa*, *Fraxinus nigra* and *Populus tremuloides* by the bromine water method described by Müller. Portions of the macerated cellulose were placed in watch-glasses and covered with the various stain solutions for two hours. The excess stain was then washed out with alcohol. In all cases a certain amount of staining was apparent, irrespective of the reported affinities of the various stains for pectin, lignin or cellulose. Lignin was prepared by the action of 72 p.c. sulphuric acid on the wood of *Catalpa speciosa* which had been previously extracted with alcohol benzene. Observations of the action of stains on the lignin so prepared, indicated that all the stains employed, with the possible exception of Congo red and Magdala red, are absorbed by the middle lamella lignin. Since Congo red has been recommended as a cellulose stain and Magdala red as a specific for lignin, no conclusions can be reached as to the selective action of these two stains, but it is clear that the remaining stains are not selective, since "cellulose" stains and "lignin" stains colour lignin with equal facility. It is not certain that cellulose and lignin extracted from wood are identical with these substances in untreated wood cells, so the effect of the various stains on sections of untreated wood was studied. Transverse sections of pine, spruce, poplar and ash were accordingly treated in the same way. In no instance was the action of any stain specific for certain layers of the cell-wall, but in all cases the middle lamella stained deepest, while the remaining wall layers showed a somewhat fainter colouration. It is concluded that staining reagents are wholly unreliable in cell-wall analyses of plant tissues. The softening action of hydrofluoric acid on wood has been interpreted simply as a process of desilification, but on close investigation the hardness of different woods cannot be correlated with the mineral content. In most cases

hardness is directly proportional to specific gravity. It is suggested that hydrofluoric acid not only desilicifies wood, but also has an effect on the basic materials of the cell-wall. The results of the phloroglucin reaction, the Maule reaction and treatment with concentrated sulphuric acid on treated and untreated wood show that hydrofluoric acid treatment affects fundamentally the chemical nature of the cell-walls.

B. J. R.

Morphology.

Life-History of *Doryanthes excelsa*.—I. V. NEWMAN ("The Life-History of *Doryanthes excelsa*. II. The Gametophytes, Seed Production, Chromosome Number, and General Conclusion," *Proc. Linn. Soc., N.S. Wales*, 1929, **54**, 411–35, 3 pls., 26 figs.). The polarity of the nuclei in the pollen grain is determined by marked vacuolation prior to the division of the microspore nucleus. After the division, the vacuolation disappears on account of food storage. Dark bodies appear in the cytoplasm as though associated with the division. The normal spindle produces generative and tube nuclei of different sizes. The generative cell precedes the tube nucleus into the pollen tube. The tip of the tube is continually being shut off by cellulose plugs. The development of the monosporial 8-nucleate embryo-sac is described. The egg-apparatus has a prominent filiform apparatus. Polar fusion takes place before pollination, usually at the base of the sac. The flower is adapted to entomophily and ornithophily, and there is a simple mechanism to impede self-pollination. The pollen tubes have been traced from pollen grains on the stigma, through the stylar canal and ovary cavity into the micropyles and on to the synergids. The "conducting" tissue is not continuous with a "placenta" as such. Fertilisation has not been seen, but has been proved by the demonstration of an embryo and by counting chromosomes. The presence of two differently staining nucleoli in the first endosperm nucleus, in addition to evidence similar to the above, makes triple fusion with a male gamete practically certain. Fertilisation in both cases seems to take place with the chromatin in a loose network, and with nucleoli present. The ripe seed is very much larger than the ovule, the increase in size outside the sac being due simply to cell enlargement. The inner integument becomes indurated. All tissues persist into the seed. The small embryo is of the *Lilium* type, slightly displaced towards the *Pistia* type. The plumule is lateral and the cotyledon terminal. The first endosperm division is accompanied by wall formation. The endosperm develops by free nuclear divisions and then by wall formation in both parts to a "basal apparatus" type. The copious endosperm is retained. The chromosome number is 22 haploid, 44 diploid, and 66 triploid (endosperm). These numbers are high among the Amaryllidaceæ, a list of whose numbers is given. It is concluded that *Doryanthes excelsa* is primitive among the Agavoideæ group and in the family.

B. J. R.

CRYPTOGAMS.

Pteridophyta.

Schizæa.—DORR RAYMOND BARTOO ("Development of Sporangium in *Schizæa rupestris*," *Bot. Gaz.*, 1930, **88**, 322–31, 20 figs.). The origin of the large solitary sporangium of *Schizæa rupestris* is marginal. The sporangium wall and tapetum arise from segments cut from a dolabrate apical cell. The primary sporogenous cell, dividing three times in succession, gives rise to 16 spore mother-cells. Then follows a rapid increase in the sporogenous mass. Not uncommon is the formation of multinucleate spore mother-cells. The relationship of Schizæaceæ to Marsiliaceæ was suggested by Campbell and supported by Bower, and this view is strengthened

by two additional features : (1) the spore output of *S. rupestris*, being reduced to 64 per sporangium, reaches the upper limit found in *Pilularia* (64-32); (2) Multi-nucleate spore mother-cells resulting from a failure of wall formation following nuclear division are a step towards the heterosporous condition of the Marsiliaceæ.

A. G.

Pteridophytes of Thuringia.—K. MÄGDEFRAU ("Die Pteridophyten Ost-Thüringens," *Hedwigia*, 1929, **69**, 148-64). An account of the ferns and fern-allies of East Thuringia, with their ecological factors and conditions. The list comprises 46 species and some varieties.

A. G.

West Asiatic Ferns.—FR. NÁBĚLEK ("Iter Turcico-Persicum, Pars V., Plantarum Collectarum Enumeratio (Gramineæ-Cryptogamæ), *Publins. Faculté des Sciences Univ. Masaryk.*, Brno, 1929, **111**, 36-9, 1 fig.). Among the 14 pteridophytes recorded in this list as having been collected in Syria, Palestine, Turkish Kurdistan and Persia, is a new variety—*glauca*—of *Polypodium vulgare* from Lebanon. Also there is a description of *Equisetum ramosissimum* var. *orientale*, the sheath, teeth and stomata of which are figured. It is recorded from North Palestine and Turkish Kurdistan.

A. G.

Kwangsi Ferns.—R. C. CHING ("Some New Species of Ferns from Kwangsi, China," *Sinensia: Contrib. from Metrop. Museum, Nanking*, 1929, **1**, 1-13). Descriptions of 14 new species and two varieties of ferns gathered during the National Research Institute expedition to the little-explored Province of Kwangsi in 1928. The total of plants collected was over 3,400, and among them is a good proportion of ferns, eight genera of which occur in the present paper.

A. G.

Bryophyta.

Marchantia.—EMMA N. ANDERSON ("Morphology of Sporophyte of *Marchantia domingensis*," *Bot. Gaz.*, 1929, **88**, 150-66, 34 figs.). At the time of fertilisation the egg and sperm nuclei in *M. domingensis* are both very conspicuous. Chromatin surrounds the nucleolus of the egg, and granular strands project from the sperm. The first appearance of the first wall is apt to vary. The early development is of the usual octant type. From the epibasal cell are formed three regions, namely, an upper sterile region of two cell-rows forming the apical cap, then the two sporogenous layers, and under them a sterile region contributing to the seta. The hypobasal cell forms the rest of the seta and the foot. The apical cap serves as a conductive system between the massive neck and the sporogenous tissue. The foot early differentiates two rows of deeply-staining cells that persist even after tetrad formation. The vertical walls of the seta appear thicker than most of the transverse walls, and the nuclei persist. Not until after the octant stage are tangential divisions begun in some cases. Sporogenous cells divide 3-4 times before spore mother-cells are formed. The sporogenous tissue consists of two transverse rows of cells, about half of which become elaters. The spiral thickenings of the elaters are foreshadowed by vacuolation of the granular peripheral protoplasm.

A. G.

Fossombronia.—ARTHUR W. HAUPT ("Studies in Californian Hepaticæ. II. *Fossombronia longiseta*," *Bot. Gaz.*, 1929, **88**, 103-8, 1 pl.). The result of an investigation undertaken to determine whether the development of the antheridium of *F. longiseta* undergoes the unique course described for it in 1906, or whether it follows the course normal to the other species of *Fossombronia*—the latter alternative was found to hold good. Incidentally, some noteworthy details of development of archegonium and embryo were discovered and are here described.

A. G.

Antheridia of *Plagiochila*.—DUNCAN S. JOHNSON ("Development of Antheridium and Spermatozoid in *Plagiochila adiantoides* Lindb. (Swartz)," *Bot. Gaz.*, 1929, **88**, 38–63, 3 pls., 4 figs.). The antheridial spike of *P. adiantoides* is conspicuous and consists of a series of 20–100 small urceolate bracts, sometimes interrupted by sterile leaves. It is simple or branched, and may persist for some years; it may contain a score of antheridia in all stages of development. This development resembles that recorded for *P. asplenoides*. In a given antheridium are some 25,000 spermatozooids, the nuclei of which become cylindric or clavate with a peripheral granular net of chromatin. The young chromosomes, at early prophase of the last division, show series of minute component granules, the chromomeres, as also do the chromosomes of the nuclei of the young spermatozooids organised immediately after this division. No constant difference in form or size was detected among the chromosomes of the same or of different spermatozooids, nor did a comparison of mitoses in male and female plants give any evidence of the presence of six chromosomes. The blepharoplast is first seen as a short rod when the nucleus of the young spermatozoid begins to elongate. No evident vacuolisation and fragmentation of the blepharoplast could be found. A. G.

Massalongo's Hepatics.—G. GOLA ("L'opéra epaticologia," in *L'Opera Botanica del Prof. Caro Massalongo per O. Mattiolo, G. Gola, A. Trotter, e A. Forti, Acad. Agric., Sci. e Lett. di Verona*, 1929, extra vol., pp. iv, 72, portrait, and 25 pls., 15 being in colour). Signor Gola gives (pp. 7–11) a summary and appreciation of Caro Massalongo's work on hepatics, which comprised 58 publications, divisible into three groups:—(1) the hepatic flora of Italy, in illustration of which the *Hepaticæ Italæ-Venetæ exsiccatae* were issued in twelve decades (1878–81); (2) hepatics from South America—Terra del Fuoco, Cape Horn, Argentina, Brazil; (3) from Schensi, China, Massalongo described 3 new genera and 75 species, some in collaboration with Bescherelle or Stephani. Three plates, with a selection of his drawings of hepatics, are given. A. G.

Peruvian Hepaticæ.—GEO. S. BRYAN ("Field Observations on Peruvian Hepaticæ," *Bot. Gaz.*, 1929, **88**, 332–42, 6 figs.). A series of field notes descriptive of a number of hepatics, thalloid and foliose, studied and collected during an expedition to the Peruvian Andes, giving their appearance in life, their environment, altitude, etc., and showing what contrasts of climate, weather, and soil or substratum control the distribution of the hepatics. A. G.

Propagules of *Fissidens*.—R. POTIER DE LA VARDE ("Observation de propagules phyllogènes chez un fissidens d'Afrique," *Ann. Crypt. Exot., Paris*, 1929, 154–7, 1 pl.). Propagules are rare in the genus *Fissidens*, and hitherto they have never been observed on the leaves. However, they have now been found so situated on the leaves of the type of *Fissidens Bryum* C.M., from Cameroon, as well as on plants from the Gaboon region. The species is known only in the sterile state. A. G.

Schistostega.—DR. LAKOWITZ ("Das Leuchtmoos im Norddeutschen Flachlande," *Hedwigia*, 1929, **69**, 301–21). This cavern-haunting moss had been known in the mountainous part of Central and Southern Germany, but not in the North German plain until 1907, when it was found near Elbing, in West Prussia, and now, in 1929, it has been found near Danzig by Dr. Koppe. A. G.

Schistidium.—JAN VILHELM ("Variabilité du genre *Schistidium* en Tchécoslovaquie," *Acta Botanica Bohemica*, 1922, **1**, 43–55, 4 figs.). A careful study of the genus *Schistidium*, resulting in an exposition of 2 sub-genera, 9 species, 3 varieties

and 27 forms, including as novelties 2 species, 1 variety and 27 forms. These are all described. A. G.

Dryptodon.—JAN VILHELM ("Variabilité du genre *Dryptodon* en Tchécoslovaquie," *Acta Botanica Bohemica*, 1923, 2, 51–3). A close investigation of the forms of *Dryptodon* in Czechoslovakia. These are grouped in 3 sub-genera and 4 species. The novelties described are a variety and 6 forms. A. G.

Serbian Bryophytes.—JOSEF PODPĚRA ("Ad Bryophytorum Haemi peninsulæ cognitionem additamentum," *Acta Botanica Bohemica*, 1922, 1, 5–25, 8 figs.). An enumeration of 36 hepatics and 241 mosses collected by the author in Serbia, Thessalonica, and on the Athos promontory, including descriptions of 2 new species and 13 new varieties. An account of his travels is given in the introduction. A. G.

Bryophytes of Montenegro.—JAN VILHELM ("Additamenta floristica in bryofloram montenegrinam," *Acta Botanica Bohemica*, 1923, 2, 46–50). A list of 67 mosses and 5 hepatics collected by Josef Rohlena during his numerous travels in Montenegro; the novelties are a sub-species, 2 varieties and a form. A. G.

South African Mosses.—H. N. DIXON and H. A. WAGER ("New and Noteworthy Mosses from South Africa," *Trans. R. Soc., South Africa*, 1929, 18, 247–61, 1 pl.). A list of 63 mosses gathered by Prof. H. A. Wager in South Africa, comprising a new genus, *Hypnofabronia*, and 11 new species, as well as new records for the country, and data of distribution additional to those recorded in T. R. Sim's "Bryophyta of South Africa." Critical notes are appended to several of the species. A. G.

Bryophytes from New Guinea.—H. REIMERS ("Beiträge zur Bryophytenflora Neuguineas," *Hedwigia*, 1929, 69, 114–36). Descriptions of 10 new mosses and one hepatic from the high mountains of Dutch New Guinea. The species and their affinities are critically discussed. There is almost a monograph of *Dawsonia*, for which genus New Guinea is more or less a centre of distribution. A. G.

Thallophyta.

Algæ.

Swarming of Dinoflagellates.—G. W. MARTIN and THURLOW C. NELSON ("Swarming of Dinoflagellates in Delaware Bay, New Jersey," *Bot. Gaz.*, 1929, 88, 218–24, 4 figs.). A description of instances of red water occurring in Delaware Bay, and due to the swarming of *Amphidinium fusiforme* and other dinoflagellates. The red colour may be due to the reddish fluorescence of the chlorophyll present in such great quantities. The cells are in dense masses, and a factor that may hold them together is the gelatinisation of the outer envelope of the active cells, not heretofore noted in this connection. A. G.

Spitsbergen Diatoms.—D. VITO ZANON ("Diatomee della Baia del Re (Swalbard)," *Mem. Pont. Accad. Sci. Nuov. Lincei*, 1929, ser. II, 12, 419–64, 1 pl.). A list of the diatoms washed from the surface of a *Laminaria* dredged up by the "Citta di Milano" in King's Bay, Spitsbergen, during the Italian Polar Expedition of 1928. A list of 119 species and half as many varieties is drawn up, and furnished with some descriptions and remarks, and in every case the habit and distribution are given, as well as a reference to a published figure in literature. Among them

are a new species of *Denticula*, and here and there new varieties and some forms. Several of the items were previously unknown for Spitsbergen. A bibliography of 30 publications on Arctic diatoms is appended, followed by a list of all the species and varieties previously recorded for the Arctic Circle, those belonging to the Spitsbergen flora being specially marked. A notable feature observed by the author is the admixture of freshwater forms among the marine. This is discussed by the author in the introduction, with *Pinnularia quadratarea* as example. A. G.

Fossil Algæ.—WILMOT H. BRADLEY ("Freshwater Algæ from the Green River Formation of Colorado," *Bull. Torrey Bot. Club*, 1929, **56**, 421-6, 2 pls.). An account, with figures, of algæ recovered by suitable treatment from the oil shale of the Green River formation, the oil of which was derived from the plankton and other life of a lake which existed for millions of years in the middle Eocene epoch. The material has been submitted to Prof. Gilbert M. Smith, and comprises the following genera: *Chroococcus*, *Crinalium*, *Hapalosiphon*, *Phacus*, *Tetraëdron*, *Cælastrum*, *Microspora*, *Stigeoclonium*, and suggestions are made as to their modern affinities. A. G.

Desmids from Bavaria.—PAUL KAISER ("Algologische Notizen IV," *Hedwigia*, 1929, **69**, 214-18, 3 figs.). A description and figures of *Euastrum starnbergense*, a new species from Starnbergersee, in Upper Bavaria, and of its variety, var. *triquetrum*. Also a discussion of *Closterium calosporum* Wittr. var. *galiciense* Gutw., found near Chiemsee, in Upper Bavaria, with a figure of its zygospore. A. G.

Chamæisiphon.—KAROL STARMACH ("Über polnische Chamæisiphon-Arten," *Acta Soc. Bot. Poloniae*, 1929, **6**, 30-45, 1 pl.). The author describes and figures a new var. of *Chamæisiphon incrustans* and 2 new species of the same genus (*Ch. sideriphilus* and *Ch. carpaticus*). He records new localities in Poland for 6 of the other species. Seventeen species in all have been recorded for the country; their distribution is given. This is followed by biological remarks on the life-conditions of the plants, on the violet-red colour of the new variety mentioned above, and on the iron-incrustation found on *Chamæisiphon sideriphilus*. A. G.

Lola lubrica.—A. ET G. HAMEL ("Sur l'hétérogamie d'une cladophoracée, *Lola* (nov. gen.) *lubrica* (Setch. et Gardn.)," *C. R. Acad. Sci., Paris*, 1929, **189**, 1094-6). The author proposes a new genus, *Lola*, to contain a Cladophoraceous alga found at Saint Suliac and Saint Servan, in Brittany, which he regards as identical with *Rhizoclonium lubricum* Setch. and Gardn.; but as the reproduction is of a heterogamous nature, a description of which he gives, the species cannot be referred to *Rhizoclonium* nor to *Chatomorpha*. The differences in cell structure are described. A. G.

Bryopsis.—MARGARET CHATTAWAY ("Protoplasmic Retractions in *Bryopsis plumosa*," *New Phytologist*, 1929, **18**, 359-68, 1 fig.). A study of the protoplasmic retractions of the siphons of *Bryopsis*. A retraction of the protoplasm from the cell walls is caused by a wound; a wound plug is quickly formed, and the alga recovers. In a solution of increased concentration shrinkage always occurs, but unless the concentration exceeds 50 p.c., the plant recovers in normal sea-water. In diluted solutions turgor occurs, or even "false" plasmolysis in still more dilute solutions; but the plant gradually recovers from the shock. In sea-water at 100° C. the alga is killed, shows coagulated protoplasm, and collapses in normal sea-water. In distilled water marked protoplasmic retraction occurs, and the plant dies. A. G.

Florideæ of Poland.—KAROL STARMACH ("Beitrag zur Kenntnis der Süßwasserflorideen von Polen," *Acta Soc. Bot. Poloniae*, 1928, 5, 367-89, 4 figs.). In the past six years the author has noted several new localities for *Hildenbrandia*, *Chantransia* 4 spp., *Batrachospermum* and *Lemanea*, and he discusses these algæ. *Hildenbrandia rivularis* occurs on shaded rocks of streams, and cannot tolerate full exposure to light. The development of the plant is briefly described; but the long hair-like outgrowths, which are produced by the thicker threads, and were called trichogynes by Petit (1881), are not trichogynes. They appear to grow into forms of *Chantransia pygmaea* or of *Ch. chalybea*, and the author discusses the question of the two latter being young stages in the life of *Hildenbrandia*, and he believes that there are two races of *Hildenbrandia* in Poland. Associated with the latter plant occurs *Dermocarpa Flahaultii*, which formerly was regarded as tetraspores of *Hildenbrandia*. A. G.

Phyllophora and Actinococcus.—L. KOLDERUP ROSENVINGE ("Phyllophora Brodiaei and Actinococcus subcutaneus," *Kgl. Danske Videnskab. Selsk. Biol. Medd.*, 1929, 8, pt. 4, 1-40, 1 pl., 18 figs.). This paper opens with a historical account of the reproduction of *Phyllophora Brodiaei*, and the belief of some authors that the "fruits" were in reality those of an epiphytic alga called *Actinococcus subcutaneus*. F. Schmitz in 1893 investigated the *Actinococcus* theory, and came to the conclusion that the nemathecial warts of *P. Brodiaei* are caused by *Actinococcus*. O. V. Darbishire (1895) held an opposite view—that the nemathecium are tetrasporangiferous organs proper to *P. Brodiaei*. In 1899 Darbishire modified his opinion, and cites incidentally Reinke's suggestion that *Actinococcus* is an asexual generation of *P. Brodiaei* growing parasitically on the sexual generation. Rosenvinge now has studied the facts, and describes the antheridia and carpogonia, the origin and development of the nemathecium, and the formation and germination of the tetraspores. The plants of *P. Brodiaei* are sexual plants that produce antheridia and carpogonia. But the carpogonia degenerate, while the auxiliary cell develops into a system of nemathecial cell filaments which give rise to seriate tetrasporangia and represent the asexual generation which is epiphytic on the gametophyte generation. Thus *Actinococcus* as a genus has no status. A. G.

Ectocarpus.—CAMILLE SAUVAGEAU ("Seconde note sur l'*Ectocarpus tomentosus* Lyngbye," *Bull. Sta. Biolog. d'Arcachon*, 1928, 25, 121-35, 2 figs.). (1) The zoospores of the plurilocular sporangia of *Ectocarpus tomentosus* produce "pléthysmothalles adélaphycées" (microscopic filamentous ramifications) which differ from the "délophycée" (visible) large phase of the plant by bearing true hairs of endogenous origin, and by forming no unilocular sporangia. Rapidly and abundantly they produce zoospores, which germinate without copulation. The author has followed this process through four generations. (2) As regards the zoospores from unilocular sporangia, they are distinctly larger than the preceding, and are almost or quite motionless. The product of their germination probably differs little from that of the zoospores of plurilocular origin. However, the subject has been too little studied for a final opinion to be yet formed. A. G.

Phæosporeæ.—C. SAUVAGEAU ("Sur les algues phéosporées à éclipse ou éclipsephycées," *Recueil Travaux Bot. Néerlandais*, 1928, 25A, 260-70). Certain annual types of brown algæ disappear during a part of the year and they make their annual reappearance. These are styled by the author "Algues à éclipse" or "Éclipsephycées." In reality, their life continues uninterrupted. Each of them has two phases as distinct from one another as the alternate generations of

Laminaria, there being a definite alternation between a large "délophycée" phase (Greek *dēlos* = visible), the ephemeral plant described in the floras, and a minute "adélophycée" (inconspicuous) phase, which multiplies its own phase for a while by means of sporangia, and finally regenerates the large visible phase. As the terms "protonema" and "prothallus" have their proper significance and are inapplicable, the author proposes for the inconspicuous phase the term "plethysmothalle" (Greek *plēthysmos* = multiplication). The author discusses several genera from this point of view.

A. G.

Development of Phæosporeæ.—CAMILLE SAUVAGEAU ("Sur le développement de quelques phéosporées," *Bull. Sta. Biolog. d'Arcachon*, 1929, **26**, 253-420, 20 figs.). In this memoir are described investigations of the development of *Dictyosiphon*, three genera of Chordariaceæ, *Stictyosiphon*, *Phyllitis*, *Scytosiphon*, *Punctaria*, *Litosiphon*, *Asperococcus*. These are followed by a general discussion of the Phæosporeæ, showing how complex are the phenomena of development in the Ectocarpales group.

A. G.

Molluscs in Ascophyllum.—TH. ARWIDSSON ("Über das Vorkommen von Mollusken in den Luftblasen von *Ascophyllum nodosum*," *Arkiv for Botanik*, 1929, **22B**, no. 1, 1-5, 1 fig.). An account of some herbarium examples of the presence of molluscs, the larva of *Mytilus edulis*, in air-bladders of *Ascophyllum nodosum*. It is pointed out that some questions require investigation:—What animal is responsible for making the openings in the air-bladders? Are the openings made on fixed or on detached algæ? Is the continued development of the mollusc inside the air-bladder voluntary or compulsory? How fast is the rate of growth as compared with growth of free molluscs in normal conditions?

A. G.

Balkan Charophytes.—JAN VILHELM ("Troisième compte-rendu sur les charophytes balcaniques," *Acta Botanica Bohemica*, 1922, **1**, 65-6). The author published in *Hedwigia*, 1907 and 1912, two previous papers on the charophytes of Bulgaria, Montenegro, and Athos Peninsula. He now adds descriptions of three new forms.

A. G.

Algæ of the Riviera.—G. OLLIVIER ("Étude de la flore marine de la Côte d'Azur," *Ann. Inst. Océanogr.*, Paris, 1929, **7**, fasc. 3, 53-173, 2 charts, 1 pl., 6 figs.). This posthumous memoir, planned as a doctorate thesis for Bordeaux University, was unfinished at the time of the author's early death. It has been put in order by Prof. C. Sauvageau. Chapter I is mainly geological. The next treats of marine biogeography. The third discusses the factors that influence the habitats in which algæ are found. Chapter IV treats of rocky substrata, zones and algal associations. Then follows the systematic account of the species, with citations of figures and ecological notes. Often the morphology and anatomy of allied species are discussed. The final chapter gives an account of the pyrenomycetous fungi found on algæ.

A. G.

Azores Algæ.—O. C. SCHMIDT ("Beiträge zur Kenntnis der Meeresalgen der Azoren II," *Hedwigia*, 1929, **69**, 95-113, 165-72, 15 figs.). An account of some 40 of the more important algæ collected in the Azores, with their localities and geographical distribution, together with critical remarks. The novelties include 3 species of *Cladophora*, 1 of *Codium*, and 1 of *Polysiphonia*.

A. G.

Fungi.

New Sclerospora from Fiji.—WILLIAM H. WESTON (*Phytopathology*, 1929, 19, 961-7, 1 text-fig.). The fungus was found on the common native "reed" *Erianthus maximus* var. *Seemanni*. The plants attacked became generally dried, withered and brown, and split into fibres; the resting spores—single oospores with thick walls—develop in great quantities. The fungus has been determined as new to science, *Sclerospora Northi*, and has been described. Its relation to other members of the genus has been noted. A. L. S.

Cytology of Peronosporaceæ.—KIN CHOU TSANG ("Recherches cytologiques sur la famille des péronosporées, étude spéciale de la reproduction sexuelle," *Le Botaniste*, 1929, 21, 1-96). The author gives a long account of work already done on this group by himself and others, and also of recent work which he has undertaken. The new research was carried out on *Cystopus* (several species) and on *Pernospora effusa*. Among other conclusions he finds as almost certain that the number of chromosomes in the mitoses of the oogonium varies between 10 and 12, or even sometimes fewer. Reduction occurs in the first division in the oospore: all development takes place in the haploid condition; the oospore alone represents the diploid, thus agreeing with many fungi. A long bibliographical list is appended. A. L. S.

Fusion of Gametes.—H. KNIEP ("Allomyces javanicus n. sp., ein Anisogamer Phycomycet mit Planogameten," *Ber. Deutsch. Bot. Gesellsch.*, 1929, 47, 199-212, 7 text-figs.). *Allomyces* is a genus of Blastocladiaceæ. A full description of the growth and development in cultures of the new species is given. The distinguishing feature observed by Kniep is the fusion of two similar planogametes and the subsequent growth of the zygote without any resting period. Instances of such fusion are known in several algæ, and it has been considered to be the most primitive form of sexual reproduction. A. L. S.

Saprolegniaceous Parasite.—D. ATKINS ("On a Fungus Allied to the Saprolegniaceæ found in the Pea-crab, *Pinnotheres*," *Journ. Marine Biol. Ass. U.K.*, 1929, 16, 203-19, 13 text-figs.). While working on pea-crabs the author found the parasite, generally in the gills, though it may penetrate deeper. The fungus has the characteristic wide hyphæ of Saprolegniaceæ without septation, and with the *Saprolegnia* type of propagation; zoospores were formed in sporangia at the tips of branches. Organs which are possibly sexual, oogonia and antheridia, appear to be rare. The whole development and the relation to the host are described, with the relationship to other members of Saprolegniaceæ. It is notable as attacking a marine invertebrate, and as occurring in sea-water, usually estuarine, but also in deep water. In contrast with *Saprolegnia*, it grows only on the living animal. When the pea-crab dies, the fungus ceases growth. It is considered possible that the fungus only invades tissue broken down by bacteria, as does *Saprolegnia parasitica* of the salmon disease. A. L. S.

Entomophthoraceæ.—WILLIAM H. SAWYER ("Observations on Some Entomogenous Members of the Entomophthoraceæ in Artificial Culture," *Am. Journ. Bot.*, 1929, 6, 87-121, 4 pls.). Sawyer discusses the history and systematic position of this family of Phycomycetes. It has always been found extremely difficult to cultivate the entomogenous forms. The writer has now succeeded in obtaining growth on many cultures, the most successful being swordfish, pork, and potato. The complete life-cycle was developed, and all the stages are described. It is hoped

that advantage may be taken of the results to promote the employment of these fungi in the destruction of harmful insects. An abundant amount of detail is given as to the culture experiments, temperature, etc. A. L. S.

A Wild Yeast.—T. J. WARD and H. F. E. HULTON ("The Incidence of Infection in Brewery Worts and Beers," *Journ. Inst. Brewing*, 1929, **35**, 466–8, 2 text-figs.). The authors describe a wild yeast which was detected in three breweries in widely different parts of the country. Microscopically it consisted in young liquid cultures of cells oval to cylindrical with rounded ends; budding occurs at the ends of the cells. On introducing the culture into a fermentable medium, the yeast cells reproduced and fermented almost immediately. Many experiments were made and the results estimated, and it was found that the yeast *Saccharomyces festinans* resembled the "top fermentation yeasts." The presence of this unwanted yeast is troublesome, owing to the rapidity with which it ferments any sugar. It can only be got rid of by severe cleansing operations of the brewery, and all utensils, scientific and otherwise. A. L. S.

Germination of Spores.—N. MALYCHEV ("Les conditions de la germination des spores du champignon *Dasycephala Wilkomii*," *Rev. Gen. Bot.*, 1929, **41**, 184–90). Germination in this fungus is somewhat feeble and slow, and a low temperature is inimical. Thus the spores are naturally inert in November, December, and January. Light has no influence. Malychev has found that he can induce germination on a jelly of larch bark extract. A. L. S.

Hawaiian Pyrenomycetes.—NEIL E. STEVENS and C. L. SHEAR ("Botryosphaeria and Physalospora in the Hawaiian Islands," *Mycologia*, 1929, **21**, 313–20, 1 text-fig.). The specimens of these two genera selected for study formed part of a large collection of material gathered in the winters of 1927 and 1928. Only two species are dealt with in the paper—*Botryosphaeria Ribis chromogena*, from 13 different hosts of 12 different genera, and *Physalospora fusca*, found on 4 host genera and species. It was proved that these and other genera of fungi were comparatively rare in Hawaii. The *Botryosphaeria* causes currant cane blight, though found on so many different hosts, among them apples, both in the States and in South Africa. The second fungus, *Physalospora malorum*, was found on a rosaceous plant and only in the pycnidial form. An account is given of other pycnidial forms and of the distribution of the various fungi in the islands. A. L. S.

Helicosporæ.—DAVID H. LINDER ("A Monograph of the Helicosporous Fungi Imperfecti," *Ann. Miss. Bot. Gard.*, 1929, **15**, 227–388, 20 pls.). The Helicosporæ are all distinguished by the coiled conidia, in some species colourless, in others shading to brown. Linder recognises in the group 11 genera and 75 species—the colouration, with the form of the conidia and conidiophores, being the chief distinguishing characteristics. He has determined the perfect ascigerous stage in connection with *Helicoma Curtisii* as *Lasiosphaeria pezizula*, having traced the life-history by means of artificial cultures. An associated ascophore, also *Lasiosphaeria*, has also been presumed to be connected with other species. The development of several of the various species is worked out, with an account of their reaction to different food supplies, temperature, moisture, etc., each species having its peculiar growth habit—sometimes the vegetative growth, at others the conidial production predominating. It was found that humidity was essential for growth and germination, with a not too high temperature. The Helicosporæ are mainly saprophytes on decaying bark and wood. A few members are parasitic on the higher plants. A. L. S.

Cercospora Species.—JAMES G. HORSFALL ("Species of *Cercospora* on *Trifolium*, *Medicago*, and *Melilotus*," *Mycologia*, 1929, **21**, 304-12, 3 text-figs.). Horsfall has presented this paper as (1) an examination of the living *Cercospora* fungi as they occur in the field, and (2) as a study of herbarium material. The specimens were collected on the above plants of Leguminosæ, conidia were examined under the microscope, and some were placed in artificial cultures. He found that conidia varied so greatly that the differences in size were of little value as systematic characters. The state of the atmosphere and the leaf characteristics of the various host plants all exerted influence on the development of the fungus. As a rule, the lesions on the leaf are striped, hence the name *Cercospora zebrina*, the fungus with which Horsfall was dealing. It grows on leaves, stems, and petioles, forming dark brown spots.

A. L. S.

Ascochyta on Leguminosæ.—RODERICK SPRAGUE ("Host Range and Life-History Studies of Some Leguminous *Ascochyta*," *Phytopathology*, 1929, **19**, 917-32, 3 pls.). The author has found that considerable confusion exists as to the species of *Ascochyta* that attack Leguminosæ. A historical sketch is given of the species described, with their effect on the host plant, and their development and characteristics. Most of those on *Vicia* were practically identical with *Ascochyta Pisi*. Another species studied was *Ascochyta pinodes* on a wide range of hosts; the perfect stage, *Mycosphaarella pinodes*, seemed to be limited to late seasons. Several other species were studied, but only in *Mycosphaarella pinodes* was the perfect ascigerous form developed. The relationship between the different species is fully discussed.

A. L. S.

Study of Fusarium.—LEON H. LEONIAN (Preface, C. D. SHERBAKOFF), ("Studies on the Variability and Dissociations in the Genus *Fusarium*," *Phytopathology*, 1929, **19**, 753-868, 18 pls.). The results of culturing *Fusarium* are often confusing, as variants are formed which complicate the determination, variability being one of the most outstanding characters of the genus. As a result of this long experimental study, it has been proved that physiological tests, such as cultures on various media, are certainly of value in tracing the species. Different species showed their differences in reaction, though it was found also that strains and species otherwise closely related showed similar differences. A large number of *Fusaria* were tested, and the results of each culture are represented in great detail in a series of tables.

A. L. S.

Sterigmatocystis basidiosepta n. sp.—A. SARTORY, R. SARTORY, and J. MEYER ("Un champignon nouveau du genre *Sterigmatocystis* (*Sterigmatocystis basidiosepta* n. sp.) à basides cloisonnées," *Ann. Mycol.*, 1929, **27**, 317-20, 1 pl.). The fungus appeared on moist hay, and was cultivated by the authors on potato and carrot. The distinctive character of the new species is the septation of the basidia into four cells. The conidia are globose and rose-coloured, becoming brown with age. No further fruiting stage was observed.

A. L. S.

Alternaria Saltant.—S. P. WILTSHIRE ("A *Stemphylium* Saltant of an *Alternaria*," *Ann. Bot.*, 1929, **43**, 653-62, 1 pl. 4 text-figs.). In the genus *Alternaria* the spores (or conidia) are elongate, muriform, and often borne in chains. In a culture from rooting grapes received from Palestine there was formed from single spore cultures a spore that conformed to the genus *Stemphylium* with its oval or oblong conidia. Cultures made from this saltant spore never reverted to *Alternaria*. Wiltshire discusses the relationship of the two genera; he considers that further data are required to solve the connection between them.

A. L. S.

Notes on French Uredineæ.—M. LIOU (TOHEN-NGO) ("Note sur quelques uredinées peu communes ou critiques récoltées dans le Midi, le Centre et l'Est de la France," *Bull. Soc. Mycol., France*, 1929, **45**, 197–215, 18 text-figs.). The author comments on the lack of attention paid and the lack of knowledge as to the geographical distribution of Uredineæ and other Micromycetes in France. He has made collecting excursions throughout Southern, Central, and Eastern France, and here publishes a selection of the specimens found, amounting to about 100 species, including 4 new to science. Special attention is given to the description of the new species, and any peculiarities of those already known are recorded, with careful attention to locality and date of growth. The text-figures are mostly of probasidia (teleutospores).
A. L. S.

Epidemiology of Stem-Rusts.—E. C. STAKMAN, M. N. LEVINE, and J. M. WALLACE ("The Value of Physiologic Form Surveys in the Study of the Epidemiology of Stem Rust," *Phytopathology*, 1929, **19**, 951–59). It was proved by this survey that the uredineal stage did not persist during the winter except in Southern States, and that spring infection came through the barberry, though the uredospores might possibly travel in spring from south to north. Thus, in 1925, a week of strong winds from Mexico, Texas, and Oklahoma was followed by a widespread and uniform infection in the spring-wheat area up to the Canadian border. A special study was made of physiologic forms, especially those of *Puccinia graminis*. These differ in the power of infection, and go far to explain the varying rust infections in different years and at different places.
A. L. S.

Uropyxis mirabilissima in Germany.—H. SYDOW ("Weitere Mitteilungen ueber das Vorkommen der *Uropyxis mirabilissima* in Deutschland," *Ann. Mycol.*, 1929, **27**, 411–12). Sydow reports many new localities for this American rust, which was first detected for Europe in Mecklenburg. He concludes that it is mainly to be found along the sea-coasts of East Prussia, from which it spreads southward.
A. L. S.

New German Ustilago.—H. SYDOW ("Eine neue deutsche Ustilaginee, *Ustilago Cichorii*," *tom. cit.*, 413–15, 2 text-figs.). The new species, *Ustilago Cichorii* Syd., is related to other members of the genus also growing on Compositæ. It injures the buds and is very destructive. Sydow observed the germination of the spores with a 4-celled promycelium, and also the formation and copulation of the conidia.
A. L. S.

A New Puccinia.—H. POEVERLEIN ("*Puccinia zelenikensis* Poev. n. sp., eine neue Umbelliferen-bewohnende Uredinee aus Dalmatien," *tom. cit.*, 416–17). The new species was found near the sea-coast in Dalmatia. Pycnidia and teleutospores are described, and the peculiarities of the new species are noted.
A. L. S.

Sexuality in Ustilago.—HANS KÄMMERLING ("Über Geschlechterverteilung und Bastardierung von *Ustilago longissima* und ihrer Varietät *macrospora*," *Zeitsch. für Bot.*, 1929, **22**, 113–42, 2 text-figs.). Hitherto the presence of more than two sexes has been demonstrated only in Basidiomycetes. Kämmerling claims to have demonstrated three, which he designates as A, B, C, in the smut of *Glyceria*, *Ustilago longissima* var. *macrospora*. After an account of its occurrence on the grass in Mecklenburg, a description of spore germination is given. Smut diploid spores produce several sporidia, one after the other, and each sporidium produces a 4- to 5-celled hypha; the sporidia may also fuse with each other and produce a binucleate "search hypha" (*suchfaden*), and these carry on infection of

the host-plant. Certain variations are noted in the germination of the spores between *U. longissima* and the variety *macrospora*. These are described at length. This smut is heterothallic, and by different combinations a third sex has been proved by the author.

A. L. S.

Ustilago on Juncus.—GEORGES MALENÇON ("*Ustilago abstrusa* sp. nov. Ustilaginée nouvelle sur Juncus," *Bull. Soc. Mycol., France*, 1929, **5**, 252–6, 8 text-figs.). The new species was found, near Cherbourg, in the ovaries of *Juncus Gerardi*, a common plant in the maritime marshes of the Channel. The spores were yellow in colour, and were localised in the vegetative parts of the organs, but it causes sterility in the plants attacked. Comparisons are made with other yellow-spored species. The author failed to secure germination of the spores, which, as he states, renders the determination as an *Ustilago* somewhat uncertain.

A. L. S.

Study of Pathogenicity.—A. H. EDDINS ("Pathogenicity and Cultural Behaviour of *Ustilago Zeæ* (Bekm.) Ung. from Different Localities," *Phytopathology*, 1929, **19**, 885–916, 7 text-figs.). The studies reported in the paper were undertaken to determine whether *Ustilago Zeæ*, as known in Iowa, differed in its ability to produce smut on inbred lines of corn—that is, the testing of pathogenicity of certain strains of smut. The investigation demanded a long series of injection experiments, 12 collections of smut in Iowa being used on lines of corn which were found to differ in susceptibility to infection. Results are tabulated of the various experiments. It was found that all of the smuts differed in their pathogenicity on the different lines of corn. *Ustilago Zeæ* is regularly heterothallic, but one monosporidial culture behaved as if homothallism also occurred. Paired monosporidial cultures were generally the most virulent. A higher percentage of infections was obtained in the greenhouse than in the field. Exact differences in pathogenicity, however, require a statistical analysis of a larger series of cultures than those yet recorded.

A. L. S.

Sexuality in Basidiomycetes.—CLARA HELDMAYER ("Ueber die Beeinflussbarkeit der Sexualität von *Schizophyllum commune* (Fr.) und *Collybia velutipes* (Curt.)," *Zeitschr. für Bot.*, 1929, **22**, 161–220, 2 text-figs.). The author has studied the cases of "sexual-mutation" in the heterothallic *Schizophyllum commune* and *Collybia velutipes*—"mutations" which had previously been proved to occur spontaneously in normally cultivated mycelium. She made use of poisons and of extremes in temperature in her cultures, and was able so to influence the development of single spore cultures that in certain combinations copulation took place. More anomalies of the kind occurred through the influence of poison than of heat. Extreme cold had considerable effect, but less than extreme heat. All these results, according to the author, seem to demonstrate the enzymatic structure of the gene.

A. L. S.

Study of *Coprinus micaceus*.—RENÉ VANDENDRIES ("Les relations entre souches étrangères expliquées par les aptitudes sexuelles des individus parthénogéniques chez *Coprinus micaceus*," *Bull. Soc. Mycol., France*, 1929, **45**, 216–48). The author worked with 11 different samples of *Coprinus* from as many different countries. Numerous crossings made between individuals resulting from the spore developments have enabled him to arrive at certain definite conclusions. Between individuals coming from distinct plants and deriving from the same mycelium, the crossings seem to obey the laws of dihybridism. Any change is due to mutation; variations in the sexuality of the same mycelium are also due to mutations. Between spawn from the same region, but sufficiently wide apart, fertility is the rule, but here again mutations may occur with resulting sterility.

Between closely-related spawns fertility is considerable, but cases of sterility also occur, due to mutations. These sterile spawns may be fertile with others from a distance, again cases of mutation. Spawns are generally sterile when grown with others from a very great distance: thus spawn from Algeria is sterile with that of Europe or America. American spawn is generally fertile with others throughout the Continent, if from localities not too widely separated. Spawn from Italy was found to give the only instance of fertility with the American. Vandendries concludes that *Coprini* spawns must be extremely mutant. Two general laws are deduced from these experiments: (1) the fungi taken at a great distance one from the other are intersterile, and (2) those from a common region are fertile. It is concluded that in the *Coprini* we have conditions that are sexually unstable, and liable to constant mutations, hence some dominant factor regulating sexuality in *Coprinus* must be sought for. The author himself finds the explanation in the presence of dominant genes which give rise to geographical races. The thesis is worked out at considerable length, and the conclusions arrived at are compared with those of Kniep.

A. L. S.

Sexuality in Agarics.—CLARA HELDMAYER ("Über die Beeinflussbarkeit von *Schizophyllum commune* (Fr.) und *Collybia velutipes* (Curt.)," *Zeitschr. für Bot.* 1929, 22, 161-220, 3 text-figs.). The work was undertaken to test the influence of culture conditions on the sex characters. Temperature and moisture were experimented with, and also a series of poisons—salts of lead, chromium, copper, mercury, etc. A parallel series of cultures was made with the spores of *Collybia* and *Schizophyllum*. In some instances the mycelium was more or less altered by the poisons. Copulation, as shown by clamp-formations, frequently took place, though abnormalities constantly occurred in the cultures. These latter, however, could not be considered as mutations, but rather as modifications, the sexual activity being more heightened or seriously hindered. The poisons used were more effective in inducing these changes than excessive heat or cold. It was found also that X-rays were without effect. A long list of reference literature completes the paper.

A. L. S.

Mushroom Culture.—EUGEN BACHMANN ("Untersuchungen über die Kulturfähigkeit des Champignons (*Psalliota campestris*)," *Zeitschr. für Bot.*, 1929, 22, 289-323, 8 text-figs.). There has always been a difficulty in inducing the germination of mushroom spores, and propagation was reduced to the use of the already formed mycelium or spawn. Bachmann has devised a sure method of securing germination and free growth of the mycelium. The spores were secured when the veil or outer covering of the cap opened, and were sown on beerwort agar in a chamber temperature of 100° C. The spores germinated regularly in 19 to 21 days, and produced an abundant mycelium. Attempts were made, mostly in vain, to shorten the period of germination, though when submitted to a hydrogen lamp illumination it was reduced to 10 days. An addition of peptone made to the culture also hastened germination. Sugar was the most important ingredient in the culture medium and the most suitable; pH value was 6.4.

A. L. S.

Cultures of *Agaricus campestris*.—EDMUND B. LAMBERT ("The Production of Normal Sporophores in Monosporous Cultures of *Agaricus campestris*," *Mycologia*, 1929, 21, 333-5, 1 text-fig.). The writer describes the method of securing freshly-formed spores and of making single spore cultures in a given medium. The growth of the mycelium from the spore was watched and transferred to sterile manure. In all cases sporophores developed quite typical of the "snow-white" variety from which the spores were taken.

A. L. S.

Notes on Russula.—R. SINGER ("Neue Mittheilungen über die Gattung Russula," *Hedwigia*, 1929, **69**, 253–61). The author discusses the systematy of *Russula cœrulea*, *R. vinosa*, *R. fusca* and *R. Mairei*. He cites the literature dealing with these species, and compares them with the allied species and forms.

A. L. S.

Armillaria mellea.—LEROY CHILDS and S. M. ZELLER ("Observations on Armillaria Root Rot of Orchard Trees," *Phytopathology*, 1929, **19**, 869–73, 1 text-fig.). Two strains of *Armillaria mellea* have been noted, one inhabiting the roots of Douglas fir, the other occurring conspicuously associated with oak trees. The land occupied by the orchard was fir-cleared, and rhizomorphs were traced from the apple-tree roots to fir snags. The trees did not suffer, as the special oak-strain of the fungus proved to be saprophytic only. The fir-strain, on the contrary, is distinctly parasitic.

A. L. S.

Revival of Dried Hexagonia Spores.—S. R. BOSE ("Revival of an Old Fruit Body of *Hexagonia discopoda* Pat. and Heriot, and Successful Spore Culture from its Fresh Spore-Discharge," *Ann. Mycol.*, 1929, **27**, 321–3, 2 text-figs.). Bose describes the fungus as old and apparently dead, collected in February, 1928. On being moistened, the specimen revived; a white mycelial coating spread over the hymenial surface, and a new hymenium was developed, on which appeared a number of conidia or secondary spores. No basidia or basidiospores were noted, but minute pores were formed, and the colouring was similar to that of the parent species.

A. L. S.

Heterothallism in Pilacre.—ANNIE M. BECKWITH ("*Pilacre faginea* proves to be a Heterothallic Fungus," *Bull. Torrey Bot. Club*, 1929, **56**, 359–60). The writer has found that single spore cultures do not develop basidia. They are produced only when strains of opposite sex are grown together. This has been proved by cultures of spores taken from different basidia. Growth was slow, but after a time basidiocarps developed if the necessary conditions of spore selection were followed.

A. L. S.

Phalloid from Palestine.—ED. FISCHER ("Eine Phalloidee aus Palästina; *Phallus roseus* Delile und die Gattung *Itajahya* Alfr. Möller," *Bev. Deutsch. Bot. Gesellsch.*, 1929, **47**, 288–95, 2 text-figs.). The specimen was sent from the neighbourhood of Jaffa, and after due examination was found to correspond with *Phallus roseus* Delile, the original specimen of which, from Damietta, was discovered and described during the Napoleonic invasion of Egypt in the years 1798 and 1799. The fungus must now be placed in the genus *Itajaha* as *I. rosea*; the rose colour of the receptacle is very striking.

A. L. S.

Italian Mycology.—C. SIBILLA ("Contributio alla flora micologica del territorio di Anagni," *Ann. di Bot.*, 1928, **18**, 253–300, 14 text-figs.). The author laments the failure of mycologists to give a sufficient mycological Flora for Italy. Records have generally been made by isolated enthusiasts working round their own dwellings. He himself has made a study of one district, Anagni, and his list, including practically all groups, amounts to 202 species. The region is of a somewhat xerophytic character, giving rise to a varied series of fungi. An index is provided of the host-plants, the parasites, and also of the fungi collected. A number of new species are described and figured in the text, mostly Ascomycetes.

A. L. S.

Fungi chinenses.—H. SYDOW (*Ann. Mycol.*, 1929, **27**, 418–34). The fungi were collected by Dr. Tai, Nanking University. The list includes a large portion of Uredineæ as well as many leaf-infecting Sphærospideæ. Among the latter is a new genus and species, *Septocytella bambusina*. Several new species of *Cerco-sporea* are also described. A. L. S.

Caucasian Fungi.—R. SINGER ("Pilze aus dem Kaukasus. Ein Beitrag zur Flora des Südwestlichen Zentralkaukasus," *Beih. Bot. Centralblatt.*, 1929, **46**, 71–113, 1 pl.). An expedition was undertaken by Singer to Central Caucasus from July to September, 1928. The different localities in which he collected are described, the nature of the soil, with the types of forest trees. He contrasts the mycological flora of the different forest lands with those of other regions. The record amounts to 240 species. A few species and varieties are new to science. A. L. S.

Fungus Flora.—JOHANN HRUBY ("Beiträge zur Pilzflora Mährens und Schlesiens I," *Hedwigia*, 1929, **69**, 173–213). This is a continuation of previous work by the author on the fungi of Moravia and Silesia. He deals here with the Peronosporineæ, a group largely represented as parasites on many different hosts. A further contribution includes the Myxomycetes, which also occurred in fairly large numbers. A. L. S.

Dominican Fungi.—ROMUALDO GONZALEZ FRAGOSO and RAFAEL CIFERRI ("Hongos parasitos y saprofitos de la republica Dominicana," *Rep. Dom. Estacion Agronom. de Moca, ser. B, Botanica*, 1928, n. 13, *Santo Domingo, R.D.*). The authors begin by a consideration of *Nematospora Gossypii*. They have made cultural and other studies of the species, and conclude that placing it in a new genus, *Ashbia* Cif. and Frag., is necessary. They list in this paper 41 species (two of them Mycetozoa) belonging to Microfungi. Several species have been described as sp. nov. *ad interim*. A. L. S.

Dominican Fungi.—R. CIFERRI ("Microflora domingenses, lista de los hongos hasta la fecha indicados en Santo Domingo," *Rep. Dominicana Estac Agronom. de Moca., Santo Domingo, R.D.*, 1929, 1–260). The work was begun with the assistance of Fragoso, now dead, and has been published by Ciferri alone. Most, if not all, of the material has appeared in previous papers, but it has been thought advisable to present a compiled account of all the species recorded, as more serviceable for future work. Ciferri proposes to publish supplements as further collections are made. He recognises three classes: I. Myxomycetes, II. Schizomycetes, and III. Fungi. The Myxomycetes are represented by nearly 40 species. The Schizomycetes are confined to those of them that are associated, as pathogens, with the higher plants. Class III, Fungi, occupy the bulk of the volume, 242 species in all, a low figure, he considers, compared with 602 for Porto Rico. Only the names and habitats are given. There follow a useful list of host-plants and a second list of other substrata on which fungi have been found, many of these being insects, and finally there is an index of genera. A. L. S.

Mycological Notes.—F. PETRAK ("Mykologische Notizen," *Ann. Mycol.*, 1929, **27**, 324–410). In these pages Petrak has criticised recently-published genera and species. A large number of the genera he represents as having been already published under other titles. The species examined are microfungi, Sphærospideæ and Ascomycetes, and full descriptions are given, with ample reasons for amendments. He himself diagnoses a number of new genera: *Apiotrabutia* (Nectriaceæ), *Paracesatiella*, *Endothyria* and *Uleothyrium* (Pyrenomycetes), *Plectosira* and *Apioporthella*

(Sphærospideæ) and *Asteronævia* (Discomycete). All are described in much detail, both genera and species. A. L. S.

Massalongo's Fungi.—ORESTE MATTIROLO ("L'opera micologica" in *l'Opera Botanica del Prof. Carlo Massalongo, Acad. Agric. Sci. e Lett. di Verona*, 1929, extra vol., pp. 1-6). Mattirollo's appreciation of Massalongo's work on mycology is included in a large work (by Mattirollo and other authors) comprising the contributions to various subjects, such as Hepatics, Cecidology, etc. Massalongo was chiefly interested in Veronese fungi, and, while collecting and preserving the smaller forms, he made a large number of drawings of the larger fugitive Agaries, etc. The 17 plates, all except one, are reproduced in colours, and deal with these larger fungi. They have been selected for publication as indicating his wide interest in the changing forms and colours that are so puzzling. A list of his writings on fungi includes 57 papers, mostly on microfungi, and to that is added a list of the fungus species, new to science, discovered and described by him, a large contribution to our knowledge of pathological forms. A. L. S.

American Microfungi.—JOHN DEARNESS ("New and Noteworthy Fungi—VI," *Mycologia*, 1929, **121**, 326-32). Dearness here describes a considerable number of new species of Hyphomycetes, most of them parasitic, and causing more or less damage to the host plants. Diagnoses are given, with descriptive notes, and affinities with other species. A. L. S.

Fungi of Czechoslovakia.—RICHARD PICBAUER ("Addenda ad Floram Czechoslovariæ Mycologicam IV," *Bull. École Supérieure d'Agronom. Brno, R.Č.S. Faculté de Silviculture*, 1929, **13**, 1-28). The writer starts with a record of 11 mycetozoa, with habitat and locality. The fungi recorded are mostly microfungi. Two species and two varieties are new to science, and are described with added Latin diagnoses. A. L. S.

Reproduction in Thallophytes.—GEORGE K. K. LINK ("Reproduction in Thallophytes, with Special Reference to Fungi," *Bot. Gaz.*, 1929, **88**, 1-37). The writer gives a sketch of the study of sexuality since the discovery by Müller of zygote formation in *Spirogyra* in 1782. He then takes up the "Role of Sexuality concept; genetic studies," touching on the successive discoveries, with special reference to Kniep's recent work on the "Sexuality of the Lower Plants." He quotes Kniep's view that "caryogamy and reduction division are the fundamental features of sexual reproduction," and there follows a discussion of the various terms used and their significance, tracing the employment of concepts and terms through the various phenomena of sexuality as discovered in the different groups of fungi and in algæ. Kniep, we are told, is inclined to postulate that the polyphyletic origin of sexuality in thallophytes indicates the diverse nature of the physiological processes leading to fertilisation. A classification of mitotic reproduction is stated as: (A) "Caryallagic" with nuclear change, and (B) Acaryallagic without nuclear change, the latter including propagation by cell-division and by buddings. These various processes and their significance, as regarding survival and evolution, are discussed. A reference list of 83 papers or books is appended. A. L. S.

Endophyte of Calluna.—M. C. RAYNER ("Phoma radicis Callunæ, a Physiological Study," *New Phytologist*, 1929, **28**, 261-90, 1 pl.). An intensive cultural study of the symbiont *Phoma* has been carried out on the same culture medium for a considerable time. The mycelium grew vigorously and became gorged with fatty materials. Its power of lignifying gelatine in these cultures

has suggested some connection with the preference of *Calluna* for neutral or acid soils. The development of bacterial colonies about the roots of the growing *Calluna* may also have some association with these characteristics. Other observations were made on the quantity and quality of the nitrogen required by the *Calluna* and by the fungus. All these questions have a bearing on the edaphic peculiarities of *Calluna* and other ericaceous plants. A. L. S.

Glycogen in Fungi.—SILVIA COLLA ("Sulla localizzazione del glicogenonei funghi e sul suo significato biologico," *Ann. di Bot.*, 1928, 18, 124-43). The author reviews the work done on this subject—chiefly by Errera—and gives an account of her methods of research. There follows a list of the plants examined. She finds that glycogen is present in all—in Phycomycetes, Ascomycetes, and Basidiomycetes. Particular attention has been given to the localisation of the glycogen. In all these classes it has been found located in the reproductive tissues, and its function ceases with the maturity of the spore. It is constantly present in conidia in gemmæ, and in all organs of dissemination. It does not occur in resting spores, nor in resting sclerotia or resting mycelium. Glycogen serves the purpose of a temporary reserve material belonging to the growing period of the fungus, of use in the development and nutrition of the fungus body, and able to pass into a simpler carbohydrate, which can again be regenerated as glycogen. A. L. S.

Disease of Elms.—J. G. BERTREM ("Das Ulmensterben und der Ulmens-pintkäfer," *Med. Laborat. Entomol., Landbon.*, 1929, 37, 284-5, 1 pl.). In a postscript to a paper on the depredations of the elm bark beetle, *Scolytus scolytus*, Bertrem has given evidence as to the part played by the insect in the dissemination of *Graphium Ulmi*, the cause of the alarming elm disease. The beetle bores holes in the bark and thus conveys the spores to the inner tissues of the trees. Cultures have been made with the dead beetle, even after sterilisation, on artificial media. The living beetle has even been simply allowed to walk over the culture, and in every case a plentiful growth of the fungus ensued. The final number of the plates illustrating the paper gives photographic representations of the fungus as grown in cultures. A. L. S.

Large Leaf-Spot of Chestnut and Oak.—GEORGE GRANT HEDGCOCK ("The Large Leaf-Spot of Chestnut and Oak associated with *Monochaetia Desmazierii*," *Mycologia*, 1929, 123, 324-5). Hedgcock describes the disease as causing leaf-spots more or less circular, with concentric zones of grey, yellow, and brown. It may cause considerable injury, but as it attacks late in the season, the damage may be slight. He gives a list of the States—mainly Florida, North Carolina, and Tennessee—in which the disease has been noted, and the trees attacked. A. L. S.

Plant Diseases in Colombia.—RAFAEL A. TORO ("Plant Disease Notes from the Central Andes—II," *Phytopathology*, 1929, 19, 969-74). This is the second paper on plant diseases due to fungi observed by the writer. They are chiefly diseases of economic plants, including coffee, sugar-cane, Avocado, cauliflower, etc. The appearance of the disease is described, with the effects on the plants, fruit production, etc. A. L. S.

Lichens.

Lichens of the Tundra.—JOHN W. HARSHBERGER ("Tundra Vegetation of Central Alaska directly under the Arctic Circle," *Proc. Amer. Phil. Soc.*, 1928, 67, 215-34 (Lichen Societies, 226-7), (16 text figs.)). Harshberger noted that the lichen societies were usually composed of a single species, the most important being

Cladonia rangiferina, of a light grey colour. The others—*Cetraria*, *Cladonia*, *Peltigera*, *Nephroma arcticum* and *Stereocaulon tomentosum*—showed various tints of brown, grey, or green, the latter colour most distinctive in wet weather. The areas covered by these societies varied in size up to many square feet. The most important economically is the reindeer lichen, on which the caribou feeds, scraping away the snow with feet and horns to get to the plants in winter. Caution is needed to avoid overcropping of the moss and thus injuring the herds of reindeer.

A. L. S.

Lichens of the Tauern Hills.—FRITZ MATTICK ("Die Flechten des Naturchutzparks in den Hohen Parken," *Hedwigia*, 1929, **69**, 262-86). The region explored by Mattick lies in the south of Salzburg, where a range of high hills (Tauern) skirts the southern boundary of the Salza Valley. On these heights is situated the Nature Reserve—the Tauern park—which encloses a region of 90 square kilometres. His results are compared with the results of Anders' study of the "Krimmler Tauern." The characteristic lichens of each locality are given—on cultivated ground, on different types of trees, solitary or in woods, and in the lower ground on stones. Mattick observed that *Lecidea*, *Lecanora* and *Pertusaria* were the first colonisers of the smooth bark of young trees, followed later by the larger form of *Parmelia*, *Cetraria*, *Usnea*, etc. He also noted that old solitary trees in the open were more covered with lichen growths than those in a wood. *Xanthoria parietina* was a frequent lichen on these isolated trees. Localities such as tree-stumps, dead wood, fences and moss-covered soil, are also described as to their lichen growths. On the ground, in well-lighted localities, *Cladonia* were abundant; in more shady places several *Peltigera* took their place. The influence of light on the lichen population on rocks was also observed. Finally the author describes the brand of lichens that inhabit the high rocks up to 2,500 m. Under the section "Biological Observations" Mattick gives notes on the rate of growth. From May to August he could detect no advance in young plants. *Xanthoria* and *Physcia* showed 2-3 cm. of growth in twelve years. He also observed the influence of light and shade on the same species. Those that were green or grey in the shade, such as *Peltigera aphthosa* and *Xanthoria*, were brighter and darker-coloured in the light. Similar notes were made on *Cladonia*. The darker colour he considers a protection against too strong insolation. Differences of form due to growth in the uplands occurred, narrow lobes and panniform varieties being frequent. The struggle for place was observed between different plants, the quicker-growing covering over the more sluggish forms. Among the quick growers were *Xanthoria parietina*, *Lecanora varia*, and *L. subfusca*, *Cetraria pinastri*, etc. There follows a list of the lichens of the Tauern Hills, with localities, altitude, etc.

A. L. S.

Porina. Species.—E. BACHMANN ("Die deutschen, felsbewohnenden Segestriaspecies," *Hedwigia*, 1929, **69**, 287-300, 9 text-figs.). Bachmann has made a minute anatomical study of the thallus of three species belonging to the *Segestria* section of *Porina*, indicating them as *Segestria lectissima*, *S. makrocarpa*, and *S. langeana*, the latter (*Porina langeana*) recently discovered by H. Lange (1929). These all are rock lichens, and exhibit the *Segestria* features of the partly thalline covering of the perithecia. The thallus in all these species is extremely thin, consisting, as in *S. langeana*, of a superficial "epinecral" layer of dead hyphal cells and empty gonidial sheaths, a thin layer of gonidia, and underneath a brown medullary and ground-layer of small angular hyphal cells with brown outer walls resembling in fine section an iron lattice-work. There are certain differences in the thalline layers of the other species. In *S. makrocarpa* there is a more massive

gonidial zone, and beneath that a layer of dead hyphal cells and empty gonidial sheaths, forming a hyponecral layer eminently adapted to absorb and retain water. The same necral layer is evident in *S. lectissima*, though the hyphal cells are more minute, while as to thalline characters, it is midway between the other two species. The perithecia were also carefully examined, and no real differences were found to exist between the three species.

A. L. S.

Lichenological Contributions—II.—GUNNAR NILSSON ("Lichenologiska bidrag.—II," *Bot. Not.*, 1929, 246–62, 2 text-figs.). Nilsson's paper contains notes on the occurrence in Scandinavia of *Parmelia incolorata*, *Evernia divaricata*, and *Peltigera lepidophora*, all rather rare lichens. He has also found *Physcia nigricans* with apothecia.

A. L. S.

New Lichen Genus.—EDUARD FREY ("Zwei lichenologische Entdeckungen," *Mitt. Nat. Ges.*, 1929, *Sonderdr.* 5, 1, 11, 2 pp., Bern). The author records the discovery of *Lecanephebe Maylani* Frey nov. gen. and sp. The new genus of Ephebeaceæ is distinguished by a lecanorine apothecium. He also found a number of specimens of *Umbilicaria* sect. *Gyphoropsis* distinguished by dark muriform spores and gyrose apothecia.

A. L. S.

Swiss Lichens.—EDUARD FREY ("Flechten," *Ber. Schweizerisch. Bot. Ges.*, 1928, 37, 110–24, and 1929, 38, 107–21.) In these two papers Frey reports on a large number of Swiss and other lichens, giving descriptions and critical notes, with the collectors, localities, etc. He thus brings Swiss lichens up to date, with much new critical information.

A. L. S.

New Lichen Genera.—EDUARD FREY ("Drei neue Flechtengattungen," *Ber. Schweiz. Bot. Ges.*, 1929, 38, 43–61, 7 text-figs.). In this paper Frey gives fuller descriptions of three new genera. *Lecanorella* gen. nov. differs from *Lecanora* in the cellular structure of the hypothecium and of the thalline margin. He compares it with the genus *Harpidium*. The gonidia are isolated in the plectenchyma, and are very reduced, so the designation *Dactylococcus* is retained. *Toniniopsis* gen. nov., distinguished also by peculiarities of thallus formation; beneath, dark brown; above, in the form of small separate groups of gonidia enclosed by compact brown cells. The systematic position of the gonidia is uncertain. The third genus, *Lecanephebe*, has been already referred to. The thallus has a plectenchymatous central strand, and the apothecia have a thalline margin, and are borne on the edges of the thallus. Each genus is monotypic, no further species having been discovered.

A. L. S.

Hungarian Lichens.—ÖDON SZATALA ("Beiträge zur Kenntnis der Flechten flora Ungarns—III," *Mag. Bot. Lapok*, 1928, 25–50, Hungarian and German). In this paper Szatala has chiefly confined himself to a study of the lichens in herbaria. He gives the names of the collectors and the localities explored, with an appreciation of the lichens, many of which he has now determined. The numbers dealt with are 170 species and 124 varieties or forms. *Cladonia* and *Parmelia* bulk very largely in the list.

A. L. S.

Further Hungarian Lichens.—ÖDON SZATALA ("Beiträge zur Kenntnis der Flechtenflora Ungarns—IV," *tom. cit.*, 68–81). Szatala contributes a continuation of the previous paper on the same lines, making more complete the publication of the lichens (with the names of the collectors) from the Hungarian National Museum at Budapest. One hundred and four species and 89 varieties are listed in this paper.

A. L. S.

Lichens of Moravia.—JOSEF PODPĚRA ("Die Vegetationsverhältnisse der Pollauer Berge. Ein Beitrag zur Pflanzengeographie Mahrem," *Acta Bot. Bohemica*, 1928, 6-7, 77-132, 4 pls.). The region examined consists of a series of limestone hills running from north to south. Lichens are included in the survey, and a list is given of certain associations, but, as the rock was seldom exposed, the number observed on the Turold is not large. Crustaceous species mainly are recorded. Silicolous species were found on dwellings and bridges in the valleys. The more important plants of the Heilige Berg are also enumerated, again almost exclusively crustaceous species on the rock or on humus. Similar calcicolous collections were made on other heights. A. L. S.

Lichens of the Tatra.—KAREL DOMIN ("The Relations of the Tatra Mountain Vegetation to the Edaphic Factors of the Habitat," *tom. cit.*, 133-63). The associations are again mainly calcicolous, but on deep humus a number of the larger lichens, *Cladonia*, *Cetraria*, etc., were abundant, and in the forest zones *Cladonia* and crustaceous corticolous lichens were observed. Finally, on granite and on quartzite, *Rhizocarpon* and *Gyrophoretum* associations were developed. A. L. S.

Lichens of Bohemia.—VÁCLAV KUTAK ("Příspěvek k lichenologii Krkonoš. Notes sur les lichens des Krkonoš," *Preslia*, 1926, 4, 20-9, Czechoslovakian with French résumé). The Krkonose or Riesengebirge lies on the north-east frontier of Bohemia, and has been frequently explored for lichens, but mainly on the Prussian side. The author gives results of his studies from the southern side. The region is mainly calcareous and ferruginous. He records many rare species, and has given anatomical and morphological details of these, such as *Catillaria Bayeri* Senft. n. sp. and *Rhizocarpon pyrenocappoides*. A. L. S.

Lichen Flora of Bohemia.—JOS. ANDERS ("Die Flechtenflora des Kummurgebirges in Nordböhmen," *Lotos*, 1928, 76, 315-25). Anders describes the region lichenologically as being in the higher zone of the district. He gives the lichen associations as: soil, ground (such as grass lands), bark, wood, rock and parasitic. Of the first association *Cladonia* are the chief constituents; they also reappear on grass lands along with *Peltigera*. The bark lichens are of very varied character—foliose, fruticose, and crustaceous—with *Cladonia* again at the base of the trees. On wood—palings, etc.—there is more restricted vegetation, but also of varied character, while the rock lichens, by far the most abundant, fall into the two categories—silicolous and calcicolous. On the former type of rock the rarest lichens were *Placodium Garovaglii* and *Parmelia Mougeotii*. *Toninia cœruleo-nigricans* grew on the calcicolous substratum, a rare lichen in Bohemia, which, along with many others, appeared as dark patches on the limestone. Among parasites he ranks species that grow on other lichens and on mosses, using these latter as substratum. Anders notes with special appreciation the occurrence of the rare and "stately" lichen *Cladonia alpestris* var. *spagnoides* Wain., recorded, so far, only from North Bohemia, though probably to be found elsewhere. Other rarities collected by him were *Peltigera lepidophora*, *Cladonia strepsilis* and *Parmelia glomellifera*, the latter abundant, though rare elsewhere. A. L. S.

Bulgarian Lichens.—ÖDON SZATALA ("Beiträge zur Flechtenflora Bulgariens.—I," *Mag. Bot. Lapok*, 1929, 82-90.) The author gives an account of a lichenological excursion in Bulgaria, but the present publication is limited to the plants found in the mountainous regions. Classes and families are well

represented, but Graphidaceæ by only four species of *Opegrapha*. Three new forms of *Lecanora* (*Aspicilia*) *cinerea* were found, one of them on beech, another, with a yellow thallus, on erupted rocks. A. L. S.

Lichen Galls.—E. BACHMANN ("Pilz- Tier- und Scheingallen auf Flechten," *Arch. f. Protistenkunde*, 1929, 66, 459-514, 60 text-figs.). Bachmann distinguishes between true galls due to the action of fungus or animal on the thallus, and false galls caused either by the formation of the lichen pycnidia or to growth stimulated unduly by the environment. He has minutely examined specimens of each kind of gall, their action on and in the thallus, and their effect on the host plant, as, for instance, in *Cladonia amaurocrea*, where fruit formation is hindered by the presence of the fungus *Metaspheria superveniens* or, as in *Pertusaria communis*, where galls caused by mites entirely inhibit the formation of the lichen apothecia. The same results were noted in *P. Wulfenii*. False galls are described in *Cetraria glauca*, due to pycnidial growth resembling isidial formations. Those observed in *Parmelia conspersa* show an unusual development of the thallus. A. L. S.

Study of Umbilicariaceæ.—EDUARD FREY ("Beiträge zur Biologie, Morphologie und Systematik der Umbilicariaceen," *Hedwigia*, 1929, 69, 219-52, 9 text-figs.). Frey explains why he has chosen Umbilicariaceæ rather than Gyrophoraceæ as the family designation for the plants discussed. He considers "Umbilicariaceæ" as having a wider meaning and as derived from an older citation than *Gyrophora*. He also calls attention to the naming of the thalline tissues. Following Lindau, he accepts plectenchyma as representing the general hyphal tissues, but applies proso- or paraplectenchyma to the tissue with elongate cells, although, as he allows, between the loose hyphal texture of the medulla "Schwammplectenchyma" to the dense cortical cells there is every stage of formation. In *Gyrophora* he finds that it is doubtful whether there is any loose medullary tissue at all. A careful anatomical study of several species is given, and the results compared with other *Gyrophoræ* or with other lichen genera. *Gyrophoræ* have an exceedingly compact, stiff structure which fits them to withstand the severe cold of the regions they inhabit by preference—the highest hills or the regions nearest the poles. As apothecia and soredia are somewhat scarce, these lichens depend on detached particles for regeneration and dispersal, and as, in moist localities, the gonidial zone may burst out in diffuse soredia, there is abundant material for dispersal. There is also a frequent formation of outgrowths or budding when cracks or splitting of the thallus takes place, and these serve for vegetative increase. As regards fruit formation and the peculiar alternation of fertile and sterile rings, he contrasts the type with the ridges in some *Graphis* apothecia and with the outgrowth in the middle of the apothecium of *Lecidea umbonata*. In each case he notes the tendency towards the suppression of the fertile tissues. A systematic discussion of different species follows. A. L. S.

Kamtchatka Lichens.—G. EINAR DU RIETZ ("The Lichens of the Kamtchatka Expeditions," *Ark. för Botanik*, 1929, 22, 13, 1-25, 2 pls.). The collections were made by Eric Hultén in 1920-22, mostly in South Kamtchatka, and comprised 250 numbers. Du Rietz lists 102 different species, including a new *Stereocaulon* and a new *Gyrophora*. Many notes are given as to systematy and habitat. A. L. S.

Relation of Cladonia Mats to Soil Moisture.—CEDRIC L. PORTER and MARJORIE L. WOOLLETT (*Torreyia*, 1929, 29, 69-71). The observations recorded were made in connection with seedling growth. It was found that when soil was

covered with a dense growth of *Cladonia rangiferina* "mats," the soil beneath these mats remained comparatively dry, so that seedlings failed to establish themselves in these areas. The *Cladonia* mats could usually absorb four and a half times their dry weight of water before any moisture passed to the soil, and though the lichen growth prevented evaporation, that was not compensation enough for the dryness caused.

A. L. S.

Lichens as Indicators of Climate.—M. CENGIA SAMBO ("I licheni come indicatori del clima," *Nuovo Giorn. Bot. Ital.*, 1929, 36, 338-59). An examination of lichens from northern Patagonia or Chubut, and from regions of Argentina, led the author to certain conclusions on lichens in regard to climate. Lichens are ubiquitous, but certain types are peculiar to certain climatic conditions. The regions round Chubut are characterised as "temperate desert climate," with an annual rainfall of about 200 mm., with climatic and trying local conditions (high winds, drifting soil, etc.), giving a desert aspect especially along the coast. On the rock faces, in more sheltered corners, lichens occur, generally crustaceous forms, poorly developed and rarely in fruit. Species of *Acarospora*, which are usually silicicolous, were observed, and a few other genera are represented. From another desert region in Somalia the lichen vegetation was largely composed of forms with blue-green gonidia—Pyrenopsidaceæ, Ephebeaceæ, and Pyrenidiaceæ—and this because the algæ are protected by gelatinous coatings able to absorb and retain water. Cengia Sambo reviews conditions of many regions with the prevailing lichens, and finally summarises these plants as: (1) desert stony (polar); (2) tundra stony; (3) cold temperate zone; (4) temperate; (5) subtropical; and (6) intertropical. She draws attention to the mountain lichens which correspond with those of high latitudes, e.g., those found above 2,400 m. in height are of polar type, and are, indeed, snow lichens. A literature list of 222 items completes the paper.

A. L. S.

Study of Gonidia.—OTTO JAAG ("Sur les gonidies des *Parmelia* et leur spécificité," *Actes Soc. Helv. Sci. Nat.*, 1928, 192-3). Jaag gives a study of the gonidia of various lichens: *Parmelia caperata* was collected from four localities and from four different trees. Each of the four specimens yielded in his cultures a different gonidium. He got similar results with *Parmelia saxatilis* and *P. acetabulum*. All the gonidia in one thallus, however, were exactly alike. In *Cladonia* the gonidia of the different species were specifically different, but they formed a special group as contrasted with those of *Parmelia*; and though those of the same *Cladonia* species differed according to locality, they yet formed a recognisable group. In general the *Cladonia* gonidia developed more quickly than those of *Parmelia*. The gonidia of the latter were, moreover, spherical, those of *Cladonia* ovoid elongate. In the cultures Jaag observed reproduction by autospores and zoospores, also the formation of gametes along with their copulation: these are isogamic or heterogamic.

A. L. S.

Mycetozoa.

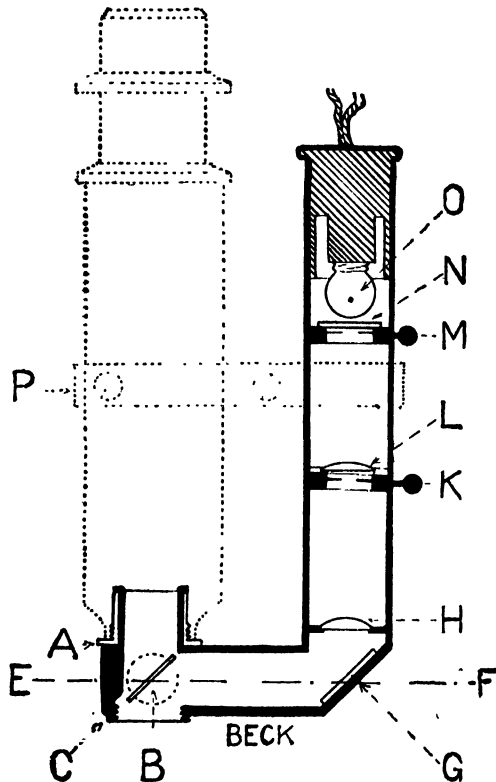
Spores of Myxomycetes.—ERNEST C. SMITH ("The Longevity of Myxomycete Spores," *Mycologia*, 1929, 21, 321-23, 1 pl.). Information on this subject has been almost entirely lacking. The writer in this investigation records results obtained with over 20 species, varying in age from 1897 onwards to 1924. In every case germination was secured in hanging drop cultures, and in some instances the number of viable spores was as great as in specimens only a year old. The time between the wetting of the spores and their germination varied somewhat according

to age, but subsequent development was normal and regular—loss of flagellum, cell-division, fusion of myxamœbæ, and formation of small plasmodia. The writer does not consider that the results would be uniform in all species, though prolonged viability must be fairly general. He draws attention to the adaptability and tenacity of this group of organisms, which during part of their life-cycle consists of naked protoplasm.

A. L. S.

TECHNICAL MICROSCOPY.

The Wrighton-Beck Metallurgical Illuminator is a modification of the optical bench apparatus devised by Wrighton for the illumination of metallurgical specimens, and described in the Journ. Roy. Micr. Soc. Ser. III, 1927, Vol. XLVII, pp. 116–27. The present instrument, which embodies the principles of the optical bench, is compact and easily attachable to any standard



microscope by means of the collar A, while the objective is attached in the position C. A thin glass reflector is carried in a fitting at B, which is operated by two milled heads, one of which rotates it on an axis at right angles to the plane of the paper, while the other rotates it on an axis, EF, so that the beam of reflected light can be adjusted in any direction. A tube which is parallel to the body of the microscope carries at its upper end, O, a small 4-volt flash-lamp bulb which can be run off an accumulator or direct from the main electric light supply

through a resistance. This lamp is placed almost in contact with a ground glass screen, N, which forms the source of illumination. The exact position of the filament in the bulb or its distance from the ground glass does not affect the quality of the illumination. It gives ample light for visual observation and for small photomicrographs, but is specially intended for visual work. Immediately below the ground glass, N, is an iris diaphragm, M, by which the size of the source of illumination can be varied. Near the centre of the tube, at K, is a second iris diaphragm, which is so placed that by means of the lens H its image is always in focus upon the specimen when a microscope tube-length of 160 mm. is used. That is to say, the distance of the image of the diaphragm K formed by the lens H is at the same distance from the reflector B as the image formed in the eyepiece giving so-called critical illumination. A lens, L, is placed close to the iris diaphragm K, of such focal length that in combination with the lens H it forms an image of the source of light, K, close to the back lens of the objective.

An apparatus of this kind, when made to project at right angles to the body of the microscope, is liable to damage and to overstrain the adjustments. The present instrument is fitted parallel to the body of the microscope, and a stainless steel mirror, G, at an angle of 45° , is used to transmit the beam of light at right angles. Where additional rigidity is required, a clamp, P, is supplied to secure the instrument to the microscope body. By means of the iris diaphragm M, an illuminating beam of light can be made just to fill the whole of the back lens of the objective, or, by using a smaller portion of its aperture, to cut off all extraneous light and reduce flare to a minimum. By means of the iris K the area of the specimen which is illuminated can be regulated, thus securing maximum contrast, while the double motion of the thin glass reflector deflects the light from north to south or from east to west.

This apparatus renders any microscope suitable for metallurgy, since, as the illuminant and the whole train of lenses and diaphragms are attached to the body and always move with it, there is not the same necessity for the focusing stage which is generally supplied on metallurgical microscopes. C. T.

NOTICES OF NEW BOOKS.

Allahabad University Studies.—Edited by the Vice-Chancellor and the Heads of Departments. Vol. IV. 1928. 489 pp., 39 plates, 7 text-figs.
Vol. V. 1929. 495 pp., 4 plates. Published by Allahabad University, Senate House, Allahabad. Price Rs. 7, As. 8 each volume.

National Physical Laboratory.—Collected Researches. Vol. XXI. 1929. 448 pp., 7 plates, 145 text-figs. Published by H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price 22s. 6d. net.

Collection Nachet.—Instruments Scientifiques et Livres Anciens. Notice sur l'Invention du Microscope et son Évolution.—By ALBERT NACHET. Liste de Savants, Constructeurs et Amateurs du XVI^e siècle. 1929. 145 pp., 16 plates. Published by Imprimerie Georges Petit, 12, Rue Godot-de-Mauroi, Paris.

Index Animalium.—By C. D. SHERBORN. 1929. Part XVIII, pp. 4451–4690. Part XIX, pp. 4691–4930. Published by the British Museum (Natural History), Cromwell Road, London, S.W. 7. Price 10s. each part.

A Monograph of the Recent Cephalopoda.—Part I. Octopodinae. By G. C. ROBSON, M.A. 1929. 236 pp., 7 plates, 89 text-figs. Published by the British Museum (Natural History), Cromwell Road, London, S.W. 7. Price 17s. 6d.

Microscope Record.—No. 19. January, 1930. 32 pp., 21 text-figs. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C. 1.

Embryology and Evolution.—By G. R. de BEER. 1929. 116 pp., 7 text-figs. Published by Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C. 4. Price 5s. net.

Encyclopédie Scientifique : La Variation et l'Evolution.—Vol. I. La Variation. By E. GUYÉNOT. 1930. xxviii, 457 pp., 46 text-figs. Published by Gaston Doin & Cie, 8, Place de l'Odéon, Paris (6°). Price 32 frs.

Medical Research Council: Special Report Series, No. 140.—Diet and the Teeth: an Experimental Study. Part I. Dental Structure in Dogs. By MAY MELLANBY. 1929. 308 pp., 109 plates, 55 text-figs. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2. Price 17s. 6d. net.

British Hardwoods : Their Structure and Identification.—By L. CHALK, M.A., D.Phil., and B. J. RENDLE, B.Sc., A.R.C.S. Department of Scientific and Industrial Research and Imperial Forestry Institute. Forest Products Research, Bulletin No. 3, January, 1929. vi, 53 pp., 45 photomicrographs. Published by H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price 5s. net.

Those experienced in the handling of timbers can usually identify woods by their general appearance. This method is, however, not at all times reliable, as certain conditions may entirely change the external appearance of the timber. It is then from the unchanged structure of wood that the timber user must seek confirmation of the identity of his specimen. The present volume describes the structure of all the more economically important British hardwoods in such a way that they may be recognised with no greater magnification than that of an ordinary hand lens. A very brief account is given of the structure of wood and the formation of annual rings, followed by a more detailed description of the principal elements of which hardwoods are composed. The hardwoods are then individually described as to their general properties, e.g., weight and texture, and the appearance at low magnification of annual rings, vessels, rays and pith flecks, as seen in a cross section. The text throughout is simple and non-technical, and admirably illustrated by suitable photomicrographs of every wood described. These descriptions and illustrations, together with the included key to the identification of the common British hardwoods, should render the book useful, not only to experienced timber users, but also to those with little or no previous knowledge of the subject.

J. L.

Diatomite: its Occurrence, Preparation, and Uses.—By V. L. EARDLEY-WILMOT. Printed at Ottawa, by F. A. Acland, for the Department of Mines, Canada, 1928. viii, 151 pp., 15 plates, loose map showing Diatomite Deposits in the Marine Provinces of Canada, and 31 text-figs. Price 30 cents.

In 1923-4 Mr. Eardley-Wilmot examined most of the Canadian diatomite occurrences in connection with the investigation of natural abrasives. It soon became apparent that the use of diatomite as an abrasive was of minor importance compared with its other uses, and a separate report on diatomite was therefore authorised. Mr. Eardley-Wilmot can be heartily congratulated on the excellence and thoroughness of his work. The opening chapter on "The Properties and Uses of Diatomite," gives a clear account of the formation of this increasingly important material from the silica skeletons of diatoms. The analyses of typical diatomites show that up to 88 p.c. of their substance is silica. As far back as the sixth century B.C. it was used by the Greeks and Romans as a building material to decrease the weight of certain structures. The two main characteristics of diatomite are its great porosity with its low apparent density, and its chemical inertness, since it contains such a large percentage of silica. These important properties indicate the main directions—though there are many others—in which diatomite has been utilised, viz., as a filtering medium, and as an insulator against heat, cold, and sound. Besides its ability to withstand a high temperature and corrosion, its myriads of enclosed air-cells form an almost perfect barrier against the influences of changes in temperature. Its use as an insulator is thus apparent. About twenty pages are taken up in describing the various ways in which the special characteristics of diatomite have been adapted in recent years to utilitarian purposes. The next chapter gives detailed practical information on the sampling, examination, and testing—microscopically and otherwise—of diatomite deposits. A third chapter bears upon markets and prices. In the fourth chapter we find that the world's production of diatomite—so far as information is available—has increased from 15,000 tons in 1913 to nearly 100,000 tons in 1926. Nearly 80 p.c. of this latter amount is mined in the United States. All the large deposits, some of which are as much as 2,000 feet in thickness—occur as dry compact beds which were formed in the Tertiary period, and are often of considerable elevation above the present level of the water. A large section of this chapter (59 pp.) describes in considerable detail the locality, nature, and extent, and particular characteristics, of all Canadian deposits which had been worked up to the time of compilation of this report. Then we have a valuable summary of information regarding similar deposits in all parts of the world. The Lompoc beds in California comprise the largest known commercial deposit, the purest of these beds being worked by the Celite Company. In chapter V full details are given with regard to the mining, preparation, and the manufacture of diatomite products. A selected bibliography will be very useful to all who are interested in this increasingly important product. The plates are well reproduced, and form a valuable adjunct to the work, which should be in the hands of all microscopists who devote their attention to diatom matters.

J. A. L.

Biological Stains.—A Handbook on the Nature and Uses of the Dyes Employed in the Biological Laboratory. By H. J. CONN. 2nd Ed. 1929. 224 pp., 5 text-figs. Published by the Commission on Standardization of Biological Stains, Geneva, N.Y., U.S.A. Price \$3.00.

When microscopists first began, in the sixties and seventies of last century, to use stains, the demand for dyes for this purpose was naturally too small to

justify a special source of supply. They therefore had to make use of textile dyes which were then very crude and inconstant in their composition. After a number of years, however, the demand for biological stains grew, and a special commercial source of supply for them first appeared in Germany in the shape of Grübler Co., later Grübler & Holborn. This company did not itself manufacture the dyes, but made some effort to obtain standard products. During the War there occurred in America, as elsewhere, a shortage of reliable stains, and an attempt was therefore made by the formation of a Commission to obtain standard biological stains, whether derived from foreign or domestic sources. The results obtained by the Commission up to 1925 were incorporated in the first edition of this book. In the four years since the first edition was published, so much, however, has been added to our knowledge of stains and staining that a large proportion of what was then written has had to be revised in the second edition. At the same time, certain staining formulæ and procedures employing these dyes have been added, more especially those that have been used in the laboratories of the members of the Commission. The whole work now forms an important contribution to the theory and technique of histological staining. It is only unfortunate that no similar means of standardising stains exists in this country, while if it is desired to test any of the dyes which have been certified by the American Commission, resort must be had to the time-honoured but immoral custom of outwitting the officers of His Majesty's Customs.

G. M. F.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, DECEMBER 18TH, 1929, MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Thomas Charles Ashby, Tonbridge.
A. Lucas, Eastbourne.
James William Smart, London.

Signing the Roll.—The following gentlemen, being present, subscribed their signatures to the Roll of Fellowship, and were duly admitted by the President :—

Thomas Charles Ashby.
Sydney Bennett Fulford.
Andrew More.
James William Smart.

Donations were reported from :—

Allahabad University—

“Allahabad University Studies.” Vols. IV and V, 1928–1929.

Messrs. Adam Hilger, Ltd.—

“The Kinematical Design of Couplings in Instrument Mechanisms.”
By A. F. C. Pollard.

Department of Scientific and Industrial Research—

“British Hardwoods : Their Structure and Identification.” By L. Chalk
and B. J. Rendle.

Votes of thanks were accorded to the donors.

Bequest.—It was reported that the late Mr. Alfred Norman Disney had bequeathed to the Society the sum of one hundred pounds, which had been duly received.

The Death was reported of :—

G. W. Young. Elected 1918.

A vote of condolence with the relatives was passed.

Nominations to New Council.—By-Laws 36–42 having been read, the nominations to Council for election at the ensuing Annual General Meeting were read and approved.

Exhibits.—Mr. Conrad Beck exhibited and described a new apparatus devised by Mr. Harold Wrighton for illuminating metallurgical and opaque objects.

Mr. Arthur Earland exhibited and described some new Foraminifera from the South Atlantic.

Papers.—The following papers were read and discussed :—

Mr. W. Wall—

“ A Trifoliate Pedicellaria in *Echinus miliaris*. ”

Mr. F. V. Welch, F.R.M.S.—

“ A Microscope Lamp. ”

Mr. J. E. Barnard, F.R.S., P.R.M.S.—

“ Note on Dark-Ground Illumination. ”

The following communication was read in title :—

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—

“ Some New Foraminifera from the South Atlantic.—II. ”

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. Beck and to Mr. Earland for their exhibits.

Announcements.—The President made the following announcements :—

The Rooms of the Society will be closed from December 23rd to December 28th, 1929.

The Biological Section will meet in the Library on Wednesday, January 1st, 1930.

The Annual General Meeting of the Society will be held on Wednesday, January 15th, 1930, to receive the Annual Report of the Council, to elect the Officers and Members of Council for the ensuing year, and the delivery of the Presidential Address.

The business proceedings then terminated.

THE ANNUAL GENERAL MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, JANUARY 15TH, 1930, DR. J. A. MURRAY, F.R.S., VICE-PRESIDENT, IN THE CHAIR.

The Chairman announced that, in the regrettable absence of the President through indisposition, he had been asked to preside on this occasion.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

The Nomination Certificate in favour of the following candidate was read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

W. H. Gillett, Brisbane.

Donations were reported from :—

Professor F. J. Cheshire, C.B.E., F.R.M.S.—

A collection of original letters of the late Professor Abbe."

Trustees of the British Museum—

" Index Animalium." Parts XVII, XVIII and XIX. Sherborn.

" Monograph of Recent Cephalopoda." Part I. Robson.

H.M. Stationery Office—

" The National Physical Laboratory. Collected Researches." Vol. XXI, 1929.

Votes of thanks were accorded to the donors.

The Death was reported of :—

Jacob Pillischer. Elected 1898.

A vote of condolence with the relatives was passed.

The Chairman called upon Dr. Tierney to announce the result of the voting upon the proposal that the time of holding the Ordinary Meetings be 5.30 p.m.

Dr. Tierney reported that a voting card had been sent to every Fellow resident in England, and the result of the voting cards returned was as follows :—

Those in favour : 203.

Those not in favour : 24.

The Annual Report of the Council for the year 1929 was read as follows :—

FELLOWS.

Since the last Annual Meeting thirty-one Ordinary Fellows and three Honorary Fellows have been elected, and one has been reinstated.

During the year the Society has lost by death five Ordinary Fellows and two Honorary Fellows, sixteen have resigned, and seventeen have been removed from the Roll under By-Law 31.

The deaths reported are as follows :—

Alfred Norman Disney. Elected 1886.
 F. R. Dixon-Nuttall. Elected 1892.
 Marshall D. Ewell. Elected 1886. Hon. Fellow 1925.
 Sir E. Ray Lankester. Elected 1865. Hon. Fellow 1928.
 John Mason Lones. Elected 1925.
 Mark Langdale Sykes. Elected 1889.
 George William Young. Elected 1918.

JOURNAL.

Several important and original communications have been published in the Society's Journal, including a complete discussion upon the Abbe Theory. The circulation continues to be well maintained, and the list of subscribers shows a further increase.

The thanks of the Society are due, and are hereby conveyed, to Dr. G. M. Findlay for his services as Acting Editor during the year, and also to the Editorial Committee and the Panel of Abstractors, through whose generous assistance the Journal as a work of reference in technical and applied microscopy continues to be maintained.

LIBRARY.

The Librarian reports that during the year the number of inquirers and visitors to the Library has considerably increased. The number of volumes issued to borrowers to December 31st, 1929, is ninety-eight, and in addition six volumes have been obtained for the use of Fellows from the Central Library for Students.

The new and complete catalogue of printed books and pamphlets in the Society's Library has been published with the assistance of the Trustees of the Carnegie United Kingdom Trust, and is available to Fellows and others interested, at a nominal cost.

Donations to the Library have been received from Messrs. Baillière, Tindall & Cox, Trustees of the British Museum, Canadian Government (Department of Mines), Messrs. Chapman & Hall, Mr. H. J. Conn, Faraday Society, M. Paul le Chevalier, McGraw Hill Publishing Co., Microscopes Nachet (Société Anonyme, Paris), Messrs. Thomas Murby & Co., Oxford University Press, Dr. Moritz v. Rohr, Royal Academy of Science, Amsterdam, Herr Theodor Steinkopff, Mr. F. B. Taylor, Messrs. Urban and Schwarzenberg, and twelve volumes and parts have been added by purchase. In addition to the foregoing, twenty volumes and a valuable collection of drawings, chiefly on the Rotifera, have been presented to the Society by the executors of the late Mr. F. R. Dixon-Nuttall.

The binding of Library sets of journals and periodicals is practically completed, and these are now available for reference.

With a view to extending the scope and usefulness of the Library to students, research workers and others interested in the literature of microscopy in physics and biology, as well as to bibliographers, the Council has decided that the Society's Library become one of the group of seventy-four outlier libraries of the Central Library for Students. This arrangement is reciprocal, and to the advantage of Fellows desiring to borrow works not already in the Society's Library.

The thanks of the Fellows are due to the Library Committee for their services during the year.

INSTRUMENTS AND APPARATUS.

The Curator of Instruments reports the following accessions to the Society's collection during the past year :—

Presented by Professor Dr. L. S. Ornstein (per Dr. P. H. van Cittert), Utrecht :—

A copy of one of Leeuwenhoek's microscopes.

Presented by the Executors of the late Mr. F. R. Dixon-Nuttall :—

Swift Challenge binocular microscope in case, with accessories.

Smith and Beck binocular microscope in case, with accessories.

Two small microscopes and telescope in case.

One dissecting microscope.

SLIDE CABINET.

The Curator of Slides reports a most welcome accession to the Society's collection in a set of one hundred and eleven slides of Foraminifera, presented by Mr. Arthur Earland, and ten paratype slides of Foraminifera from the Discovery Expedition, 1925-27, presented by Mr. E. Heron-Allen and Mr. Arthur Earland. In addition, a collection of one hundred and thirty slides of Rotifers, etc., have been added by donation from the Executors of the late Mr. F. R. Dixon-Nuttall, and Mr. John Richardson has presented to the Cabinet a slide of the "Fairy Beetle," *Trichopterygidæ atomaria*. Five slides have been borrowed from the Society's Cabinet.

MEETINGS.

Nine Council Meetings and eight Ordinary Meetings of the Society have been held during the year, and the attendance has been well maintained. Following upon a paper last year by Dr. H. Moore on "The Mode of Formation of the Image in the Microscope" (see Journ. R.M.S., ser. III, vol. xlviii, pp. 133-43), an important discussion upon the Abbe Theory, in which several authoritative contributors took part, was held in March, and full report of this discussion is published in the Society's Journal.

The Annual Pond Life and General Microscopical Exhibition was held in October, instead of June as hitherto, and the Council is happy to report an increased number of exhibitors at this meeting, which was well attended.

During the year the Council has been asked to consider a proposal from Fellows that the time of holding the Ordinary Meetings of the Society should be altered to an earlier hour, in conformity with other scientific bodies meeting in London, in order to afford Fellows living at a distance a more convenient opportunity of attending the Society's meetings. A card vote of the Fellows resident in England has been taken on this proposal, which has resulted in an overwhelming majority in favour of holding the meetings at 5.30 p.m., preceded, if found practicable, by tea at 5 o'clock. Council is, therefore, endeavouring to effect the desired alteration as soon as possible, notice of which will be circulated to Fellows in due course.

The Secretary of the Biological Section reports that the number of short notes on interesting subjects contributed at these meetings has been maintained and the attendances have been good. Dr. J. A. Murray announces with regret that his official duties have compelled him to relinquish the Secretaryship of the Section, and is glad to report that, with the approval of Council, Mr. D. J. Scourfield, the founder of the Section, has again consented to act as Secretary.

The Council conveyed its congratulations to the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, on the occasion of that Society's Centenary Celebrations held at Newcastle during the year, and appointed Mr. Charles Ranken, of Sunderland, to represent the Society on that occasion.

The Council announces with regret that, by the effluxion of time, the Society's lease of premises at 20, Hanover Square, expires very shortly. This important matter has engaged its serious consideration during the year, and it is hoped to call a Special General Meeting of the Fellows at an early date to consider a proposal thereon.

In the efficient discharge of the general work of the office and the work of the Library, the assistance rendered by Miss C. W. Simpson merits commendation.

The thanks of the Society are due, and are hereby conveyed, to the following firms: Messrs. R. & J. Beck and Messrs. E. Leitz (London), who have kindly loaned instruments and apparatus at its meetings and demonstrations during the year.

On the motion of Mr. Conrad Beck, seconded by Dr. E. W. Bowell, the following resolution was carried unanimously:—

“That the Annual Report be received and adopted.”

Mr. T. H. Hiscott moved, and Mr. G. T. Gurr seconded:—

“That a very hearty vote of thanks be tendered to the officers and members of the Council for their services during the past year.”

Carried.

Professor R. Ruggles Gates responded.

THE ELECTION OF OFFICERS AND MEMBERS OF COUNCIL.

The Chairman appointed Mr. J. Wilson and Mr. E. Cuzner to act as scrutineers of the ballot for the election of officers and members of Council for the ensuing year, and afterwards declared the result of the ballot as follows:—

President.—R. Ruggles Gates, M.A., Ph.D., F.L.S.

Vice-Presidents.—F. W. Rogers Brambell, B.A., D.Sc., Ph.D.; W. E. Cooke, M.D., F.R.C.P., D.P.H.; A. S. Parkes, M.A., D.Sc., Ph.D.; E. A. Robins, F.L.S.

Treasurer.—Cyril F. Hill, M.Inst.M.M., A.Inst.P.

Secretaries.—J. E. Barnard, F.R.S., F.Inst.P.; Clarence Tierney, D.Sc., F.L.S.

Ordinary Members of Council.—W. E. Watson Baker, A.Inst.P.; W. A. F. Balfour-Browne, M.A., F.R.S.E., F.Z.S., F.E.S.; E. W. Bowell, M.A., M.R.C.S., L.R.C.P.; A. Earland; G. M. Findlay, O.B.E., M.D., D.Sc.; J. E. McCartney, M.D., Ch.B., D.Sc.; Doris I. Mackinnon, D.Sc., F.L.S.; J. H. Pledge; J. Rheinberg, F.Inst.P.; G. S. Sansom, D.Sc.; D. J. Scourfield, I.S.O., F.L.S., F.Z.S.; E. J. Sheppard.

Librarian.—Clarence Tierney, D.Sc., F.L.S.

Curator of Instruments.—W. E. Watson Baker, A.Inst.P.

Curator of Slides.—E. J. Sheppard.

The Chairman proposed a vote of thanks to the scrutineers, which was carried.

The Chairman announced that, in the absence of the President, the Presidential Address would be postponed until the Ordinary Meeting in March.

The following paper was read and discussed :—

Mr. T. D. Hamilton, F.R.M.S.—

“The Preparation of Thin Microscope Sections of Whole Organs by the Paraffin Method.”

Communicated by Mr. W. E. Watson Baker.

Professor R. Ruggles Gates, M.A., Ph.D., F.L.S., the new President, was then inducted to the Chair, and returned thanks for his election.

The following communication was then read and discussed :—

Dr. W. E. Cooke, M.D., F.R.C.P., D.P.H., F.R.M.S.—

“Further Observations on Pulmonary Asbestosis..”

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. W. E. Watson Baker for communicating the paper by Mr. T. D. Hamilton.

It was announced that the Biological Section would meet in the Library on Wednesday, February 5th, at 7.30 p.m.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, LONDON, W: 1, ON WEDNESDAY, FEBRUARY 19TH, 1930, PROFESSOR R. RUGGLES GATES, M.A., Ph.D., F.L.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

W. H. Gillett, Brisbane.

The Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

As Ordinary Fellows :—

Miss D. Erikson, B.A., Richmond.

F. J. Fraser, M.Sc., Ottawa.

H. J. Harper-Roberts, Liverpool.

W. Faitoute Munn, B.S., West Orange.

J. A. Reddie, F.I.C., Bradford.

As Honorary Fellow :—

Professor E. B. Wilson, Columbia University.

Donations were reported from :—

MM. Gaston Doin & Cie—

“La Variation et l'Évolution. Tome I. La Variation.” By E. Guyénot.

Oxford University Press—

“Embryology and Evolution.” By G. R. de Beer.

Medical Research Council—

“Diet and the Teeth. Part I. Dental Structure in Dogs.” By May Mellanby.

Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne—

“History of the Society, 1829–1929.” By T. Russell Goddard.

Professor Hans de Winiwarter—

A collection of published communications by the donor.

Dr. Peyton T. B. Beale, F.R.C.S., F.R.M.S.—

Portable Microscope and Accessories by Swift, c. 1878.

Mr. J. Rheinberg, F.R.M.S.—

Set of photographic copies of the original letters (recently presented to the Society by Professor F. J. Cheshire) from Abbe to Stephenson, 1875–1886.

Votes of thanks were accorded to the donors.

Papers.—The following communications were read and discussed :—

Dr. Reginald S. Clay, B.A., D.Sc., F.Inst.P., F.Op.S., F.R.M.S., and Mr. Thomas H. Court—

“Early Achromatic Microscopes by James Smith.”

Mr. D. V. Daran, B.A.—

(1) “Coincident Images made use of in Mycological and Bacteriological Works with Reference to Single Spore Cultures.”

(2) “Reflection Magnification used for Physiological Experiments connected with Transpiration.”

(3) “A Note on Illuminating Objects for Microscopical Examination.”

The following papers were read in title :—

Mr. Hardit Singh Rai, M.Sc.—

“On the Origin of Yolk in the Egg of *Ostrea cucullata*.”

Mr. E. Heron-Allen, F.R.S., and Mr. Arthur Earland, F.R.M.S.—

“Some New Foraminifera from the South Atlantic.—III. *Mibiammina* : A New Siliceous Genus.”

Votes of thanks were accorded to the authors of the foregoing communications.

The President announced that the Biological Section would meet in the Library on Wednesday, March 5th, 1930, at 7.30 p.m.

The business proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1930.

TRANSACTIONS OF THE SOCIETY.

VIII.—THE FORAMINIFERA OF THE PLYMOUTH DISTRICT.

II.

By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.

(Continued from p. 84, *J. Roy. Micr. Soc.*, Ser. III, vol. L, Pt. 1, March, 1930.)

TWO PLATES.

CORRIGENDUM.—On page 54, *sub* ***Miliolina trigonula*** the salinities have been given as “per cent.” This should have been “per mille.”

Family—Lagenidæ.

Sub-Family—Lageninæ.

LAGENA Walker and Boys.

125. ***Lagena globosa*** (Montagu).

Serpula (*Lagena*) *lævis globosa* Walker & Boys, 1784, TMR, p. 3,
pl. i, fig. 8.

Lagena globosa Brady, 1884, FC, p. 452, pl. lvi, figs. 1–3.

Stations 1, 2, 4–8.

Frequent but rather small. The best at Station 4, where a fine specimen with ento-ectosolenian apertures was found, and at Stations 5 and 6.

126. *Lagena apiculata* (Reuss).

Oolina apiculata Reuss, 1851, FKL, p. 22, pl. i, fig. 1.

Lagena apiculata Parker, Jones & Brady, 1866, etc., MFC, 1866, p. 44, pl. i, fig. 27.

Stations 2, 4, 7.

A single specimen at each station.

127. *Lagena lineata* (Williamson).

Entosolenia lineata Williamson, 1848, BSGl, p. 18, pl. ii, fig. 18.

Lagena lineata Reuss, 1863, FFL, p. 328, pl. iv, fig. 48.

Stations 1, 2, 4, 7, 8.

Frequent excepting at Station 1, and very common at Stations 2 and 4.

128. *Lagena reticulata* (Macgillivray).

Lagenula reticulata Macgillivray, 1843, HMAA, p. 38.

Lagena reticulata Reuss, 1862, FFL, p. 333, pl. v, figs. 67, 68.

Stations 2, 7, 8.

Very rare at Station 2. A doubtful specimen at Station 7, and one at Station 8.

129. *Lagena hexagona* (Williamson).

Entosolenia squamosa, var. *hexagona* Williamson, 1848, BSGl, p. 20, pl. ii, fig. 23.

Lagena hexagona Brady, 1884, FC, p. 472, pl. lviii, figs. 32, 33.

Stations 2, 3, 4, 6, 7, 8.

Common. Best at Stations 2 and 4.

130. *Lagena squamosa* (Montagu).

Vermiculum squamosum Montagu, 1803-8, TB, p. 526, pl. xiv, fig. 2.

Lagena squamosa Cushman, 1910, etc., FNP, 1913, p. 16, pl. vi, fig. 1.

Stations 1, 2, 4-8.

Common and very variable in strength of marking. The best specimens at Stations 4 and 5.

131. *Lagena squamosa*, var. *montagui* (Alcock).

Entosolenia montagui Alcock, 1865, NHC, p. 206.

Lagena squamosa, var. *montagui* Wright, 1900, DBC, p. 54, pl. ii, fig. 2.

Lagena squamosa, var. *montagui* Heron-Allen & Earland, 1913, CI, p. 76, pl. vii, figs. 11, 12.

Station 4.

A single typical specimen of this unsatisfactory variety.

132. *Lagena catenulata* Reuss.

(Not *Entosolenia squamosa*, var. *catenulata* Williamson, 1848, BSGl, p. 19, pl. ii, fig. 20.)

Lagena catenulata Reuss, 1862, FFI, p. 332, pl. vi, fig. 75 (only).

Lagena catenulata Heron-Allen & Earland, 1922, TN, p. 152, pl. v, figs. 16-18.

Station 6 (*New to Britain*).

A specimen identical with Reuss's fig. 75. We went carefully into the question of the nomenclature of this species in our T.N. paper (*ut supra*).

133. *Lagena melo* (d'Orbigny).

Oolina melo d'Orbigny, 1839, FAM, p. 20, pl. v, fig. 9.

Entosolenia squamosa, var. *catenulata* Williamson, 1848, BSGl, p. 19, pl. ii, fig. 20.

Lagena melo Brady, Parker & Jones, 1888, AB, p. 222, pl. xlv, fig. 21 (only).

Station 6.

A typical specimen.

134. *Lagena laevis* (Montagu).

Vermiculum laeve Montagu, 1803, TB, p. 524.

Lagena laevis Williamson, 1848, BSGl, p. 12, pl. i, figs. 1, 2.

Lagena laevis Heron-Allen & Earland, 1913, CI, p. 77, pl. vi, fig. 5.

Stations 2, 4, 5, 6, 8.

Curiously rare. The best at Station 4, where the curved form which we figured from Clare Island also occurs.

135. *Lagena clavata* (d'Orbigny).

Oolina clavata d'Orbigny, 1846, FFV, p. 24, pl. i, figs. 2, 3.

Lagena clavata Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 660, pl. L, fig. 23.

Stations 2, 4, 8.

Rare. The most typical specimens at Stations 2 and 4.

136. *Lagena gracillima* (Seguenza).

Amphorina gracilis Costa, 1853, etc., PRN, 1856, p. 121, pl. xi, fig. 11.

Amphorina acuminata Seguenza, S, 1862, FMMM, p. 51, pl. i, fig. 35.

Amphorina gracillima Seguenza, S, 1862, FMMM, p. 51, pl. i, fig. 37.

Stations 2, 4, 6.

A few specimens which we regarded at first as abnormally produced *L. clavata* (d'Orb). They agree, however, with Seguenza's figure of *Amphorina acuminata*, which is usually regarded as a synonym of his better-known species *L. gracillima*. The difference between Seguenza's species lies only in the fact that the aboral end of *acuminata* is produced but not perforate as in *gracillima*.

137. *Lagena gracilis* Williamson.

Lagena gracilis Williamson, 1848, BSGL, p. 13, pl. i, fig. 5.

Lagena gracilis Brady, 1884, FC, p. 464, pl. lviii, figs. 2, 3, 7-10, 19, 22-24.

Station 4.

A few specimens only at this station.

138. *Lagena striata* (d'Orbigny).

Oolina striata d'Orbigny, 1839, FAM, p. 21, pl. v, fig. 12.

Lagena striata Brady, 1884, FC, p. 460, pl. lvii, figs. 22, 24, 28, 29, etc.

Stations 2, 4, 5, 6, 8.

Very rare, the best at Station 4.

139. *Lagena semistriata* Williamson.

Lagena striata, var. *semistriata* Williamson, 1848, BSGL, p. 14, pl. i, figs. 9, 10.

Lagena semistriata Jones, Parker & Brady, 1866, etc., MFC, 1866, p. 34, pl. iv, fig. 6.

Stations 1, 2, 4, 6, 8.

Fairly frequent, the best at Stations 4, 8. Specimens vary greatly in development of the costæ.

140. *Lagena crenata* Parker and Jones.

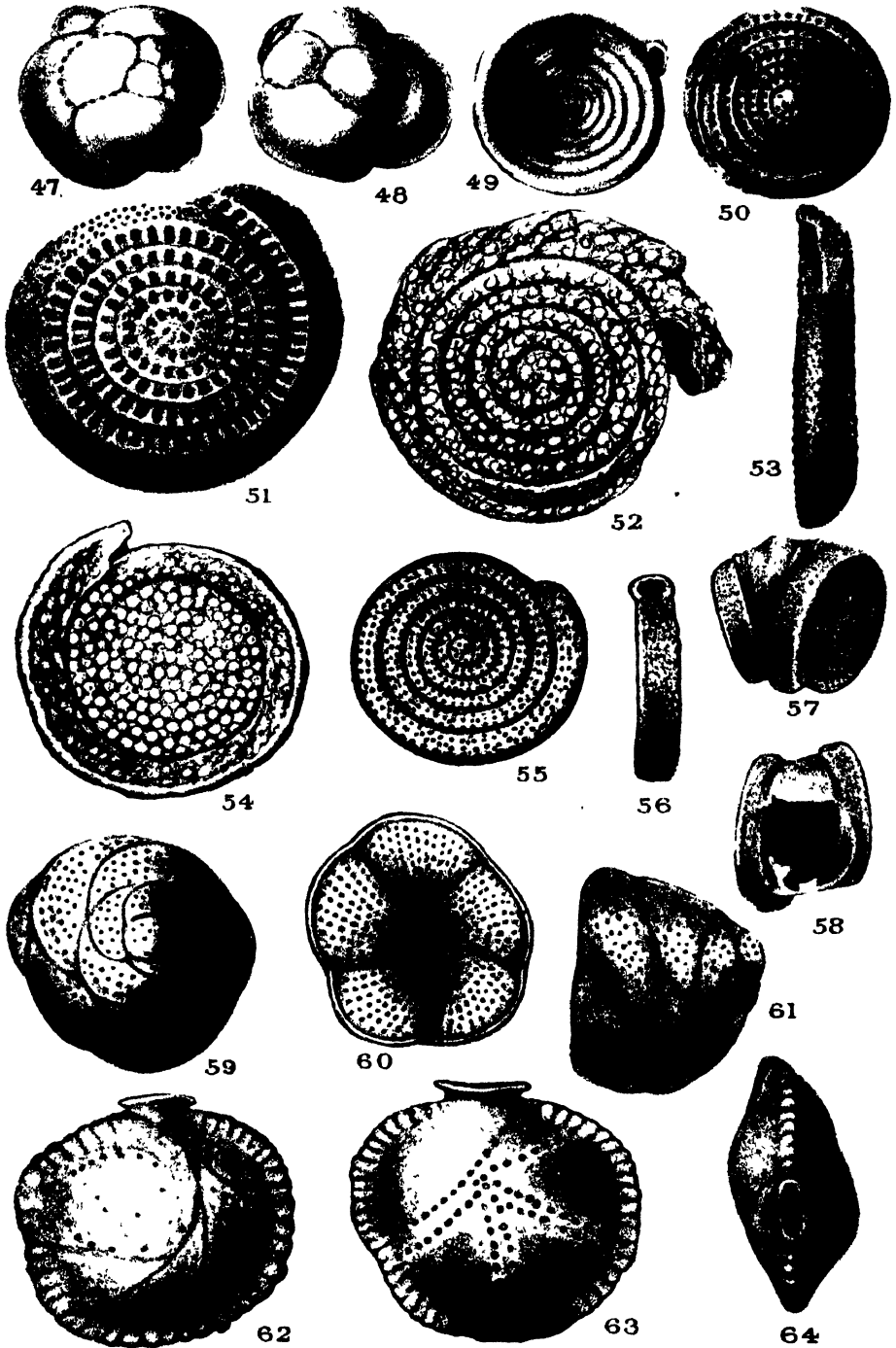
Plate III, figs. 41, 42.

Lagena crenata Parker & Jones, 1865, NAAF, p. 420, pl. xviii, fig. 4.

Lagena crenata Brady, 1884, FC, p. 467, pl. lvii, figs. 15, 21.

Station 4.

A single abnormal specimen in which the costate base, instead of being flat as usual, is turned at a sharp angle upwards, the costæ continuing over the basal half of the body of the shell. It is thus intermediate between *L. crenata* and *L. semistriata*, but is undoubtedly referable to the first species.



141. *Lagena perlucida* Williamson.

Lagena vulgaris, var. *perlucida* Williamson, 1858, RFGB, p. 5, pl. i, figs. 7, 8.

Lagena perlucida Heron-Allen & Earland, 1908, etc., SB, 1911, p. 320, pl. x, fig. 13.

Stations 2, 6, 8.

Our specimens, one of which was found at each station, agree with both the figures given by Williamson, which differ materially from the original figure of *Vermiculum perlucidum* of Montagu (1803, TB, p. 526, pl. xiv, fig. 2), which suggested Williamson's name. It would appear that to Montagu should really be ascribed the authorship of the species, but, excepting by Brown in 1827 (& 1844) (Illustrated Conchology of Great Britain, fly-leaf, pl. i, fig. 29), the authorship has always been given to Williamson.

142. *Lagena sulcata* (Walker and Jacob).

Serpula (Lagena) striata sulcata rotundata Walker & Boys, 1784, TMR, p. 2, pl. i, fig. 6.

Lagena sulcata Brady, 1884, FC, p. 462, pl. lvii, figs. 23, 26, 33, 34 (Refs. H.-A. & E., 1914, etc., FKA, 1915, p. 659).

Stations 2, 4, 6, 7, 8.

Frequent and well developed. At Station 4 one specimen had the costæ arranged spirally round the body of the shell, as in the specimens recorded by us in 1915 (FSC, p. 45); also specimens without the characteristic neck.

143. *Lagena sulcata*, var. *interrupta* Williamson.

Lagena striata, var. *interrupta* Williamson, 1848, BSGL, p. 14, pl. i, fig. 7.

Lagena sulcata, var. *interrupta* Brady, 1884, FC, p. 463, pl. lvii, figs. 25, 27.

Stations 2, 4, 6, 7, 8.

As usual, this variety occurs with the type.

144. *Lagena williamsoni* (Alcock).

Entosolenia williamsoni Alcock, 1865, NHC, p. 195.

Lagena williamsoni Wright, 1877, RFDA, App. p. 104, pl. iv, fig. 14.

Stations 1, 2, 4-8.

Common and variable, best at Station 8.

145. *Lagena lyellii* (Seguenza).

Amphorina lyellii Seguenza, 1862, FMMM, p. 52, pl. i, fig. 40.

Lagena lyellii Brady, 1870, FTR, p. 292, pl. xi, fig. 7.

Stations 1, 4.

Very rare, the best at Station 4.

146. *Lagena striato-punctata* Parker and Jones.

Lagena sulcata, var. *striato-punctata* Parker & Jones, 1865, NAAF, p. 350, pl. xiii, figs. 25-27.

Lagena striato-punctata Goës, 1894, ASF, p. 88, fig. 753.

Station 6.

A single specimen of the strongly-marked northern type figured by the authors and subsequently by Goës. It is very different from the tropical form figured in the "Challenger" report (pl. xx, fig. 3).

147. *Lagena costata* (Williamson).

Entosolenia costata Williamson, 1858, RFGB, p. 9, pl. i, fig. 18.

Lagena costata Reuss, 1862, FFL, p. 329, pl. iv, fig. 54.

Stations 2, 6.

Weak specimens and very rare.

148. *Lagena stewartii* J. Wright.

Lagena stewartii Wright, 1910-11, ECM, p. 12, pl. ii, fig. 8.

Lagena stewartii Heron-Allen & Earland, 1913, CI, p. 81, pl. vi, figs. 2, 3.

Station 2.

Very rare.

149. *Lagena laevigata* (Reuss).

Fissurina laevigata Reuss, 1849-50, FOT, p. 366, pl. i (xlvi), fig. 1.

Lagena laevigata Brady, 1884, FC, p. 473, pl. cxiv, fig. 8.

Stations 1, 2, 4-8.

Uncommon and not very typical. Best at Station 4.

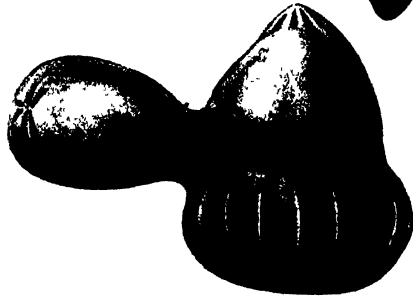
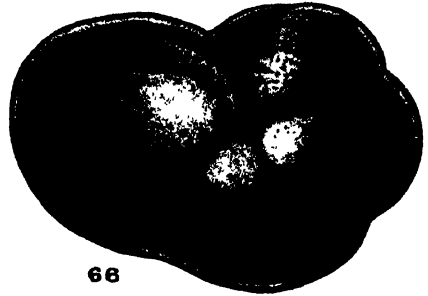
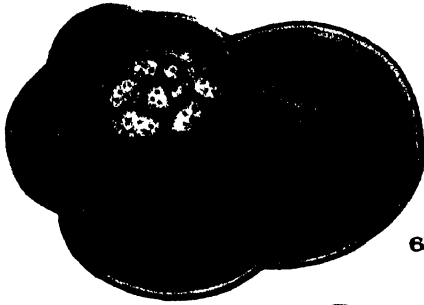
150. *Lagena acuta* (Reuss).

Fissurina acuta Reuss, 1858, FP, p. 494; and Reuss, 1862, FFL, p. 340, pl. vii, figs. 90, 91.

Lagena acuta Brady, 1884, FC, p. 474, pl. lix, fig. 6.

Stations 4, 6.

Weak and very rare.



151. *Lagena millettii* Chaster.

Lagena millettii Chaster, 1892, CS, p. 61, pl. i, fig. 10.

Lagena millettii Heron-Allen & Earland, 1913, CI, p. 83, pl. vi, fig. 10.

Stations 2, 4.

One perfect specimen of this very striking species at each station.

152. *Lagena falcata* Chaster.

Lagena falcata Chaster, 1892, FS, p. 61, pl. i, fig. 7.

Lagena falcata Heron-Allen & Earland, 1913, CI, p. 82, pl. vi, figs. 12, 13; FWS, p. 249, pl. 41, fig. 25.

Station 2.

One specimen of the short subglobular form figured by us from Clare Island (fig. 12 *supra*) and West Scotland (fig. 25 *supra*).

153. *Lagena lucida* (Williamson).

Entosolenia marginata, var. *lucida* Williamson, 1858, RFGB, p. 10, pl. i, figs. 22, 23.

Lagena lucida Balkwill & Millett, 1884, FG, p. 80, pl. ii, fig. 7; pl. iii, figs. 4, 5.

Stations 1, 2, 4-8.

Common. Occurs in two forms, a long narrow variety and a short broad one, the latter being the more abundant. Trigonal specimens occur at Stations 2, 4, 6. Both varieties occur in the trigonal condition. See our observations on the Cornish forms of this species (FSC, p. 46).

154. *Lagena schlichti* (Silvestri).

Fissurina carinata (pars) Reuss, 1870, FSP, p. 469. (See Schlicht, 1870, FSP, pl. v, figs. 1-3.)

Fissurina schlichti Silvestri, 1902, LMT, p. 143, text-figs. 9-11.

Lagena schlichti Chapman, 1909, SNZ, p. 337, pl. xv, figs. 7 a, b.

Stations 2, 4.

Very rare and far from typical. The species was recorded as British by us from West Scotland in a preliminary note (Liverpool M. B. C. Ann. Rep., 1913), but subsequently abandoned in 1915 in FWS, p. 198 (footnote).

155. *Lagena marginata* (Walker and Boys).

Serpula (Lagena) marginata Walker & Boys, 1784, TMR, p. 2, pl. i, fig. 7.

Lagena marginata Brady, 1884, FC, p. 476, pl. lix, figs. 21-23.

Stations 2, 4-8.

Frequent everywhere and very common at Stations 4 and 6, and presenting every range of variation in the width of the carina. Best at Stations 2 and 4; very rare at Station 5.

156. *Lagena marginata*, var. *inaequilateralis* Wright.

Lagena marginata, var. *inaequilateralis* Wright, 1885-6, BLP, p. 321, pl. xxvi, fig. 10.

Lagena marginata, var. *inaequilateralis* Sidebottom, 1904, etc., RFD, 1906, p. 10, pl. ii, fig. 6.

Stations 1, 2, 4.

Rather rare. A very good selection of typical specimens at Station 4.

157. *Lagena quadrata* (Williamson).

Entosolenia marginata, var. *quadrata* Williamson, 1858, RFGB, p. 11, pl. i, fig. 27.

Lagena quadrata Brady, 1884, FC, p. 475, pl. lix, figs. 3, 16; pl. lx, fig. 5.

Stations 2, 4.

Frequent. Two well-marked forms (*a*) square (*b*) oblong occur at each station. Most specimens are fissurine and entosolenian, but a few exhibit a well-marked produced neck, flattened to form a fissurine aperture. These also have an attached entosolenian tube.

158. *Lagena malcomsonii* J. Wright.

Lagena laerigata, var. *malcomsonii* Wright, 1910-11, BCNI, p. 4, pl. i, figs. 1, 2.

Lagena malcomsonii Heron-Allen & Earland, 1913, CI, p. 84, pl. vi, fig. 9.

Stations 2, 4.

Very much rarer than *L. quadrata*, but typical specimens at the stations where that species is common.

159. *Lagena marginato-perforata* Seguenza.

Lagena marginato-perforata Seguenza, 1879-80, FTR, p. 332, pl. xvii, fig. 34.

Lagena marginato-perforata Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 663, pl. L, figs. 24-30.

Station 7.

Two weakly-marked specimens.

160. *Lagena annectens* Burrows and Holland.

Lagena annectens Burrows & Holland, in Jones, Parker & Brady, 1866, etc., MFC, 1895, p. 203, pl. vii, fig. 11.

Lagena annectens Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 662 (Refs.).

Stations 2, 4.

Weak and very rare, the best at Station 2.

161. *Lagena bicarinata* (Terquem).

Fissurina bicarinata Terquem, 1882, FEP, p. 31, pl. i (ix), fig. 24.

Lagena bicarinata Balkwill & Millett, 1884, FG, p. 82, pl. ii, fig. 4; pl. iii, fig. 9.

Lagena bicarinata Heron-Allen & Earland, 1915, FSC, p. 46, pl. vii, figs. 2, 3.

Stations 2, 5, 6.

Very rare, a few specimens only at each station.

162. *Lagena rizzae* (Seguenza).

Fissurina rizzae Seguenza, 1862, FMMM, p. 72, pl. ii, fig. 50.

Lagena rizzae Heron-Allen & Earland, 1913, CI, p. 89, pl. vii, fig. 9.

Lagena quadrata, var. *rizzae* Cushman, 1910, etc., FNP, 1913, p. 35, pl. xix, fig. 4.

Station 4.

Several good specimens at Station 4.

163. *Lagena orbignyana* (Seguenza).

Fissurina orbignyana Seguenza, 1862, FMMM, p. 66, pl. ii, figs. 25, 26.

Lagena orbignyana Brady, 1884, FC, p. 484, pl. lix, figs. 1, 18, 24-26.

Stations 1, 2, 4-8.

Frequent and well developed everywhere. Trigonal specimens at Stations 2, 4. There is a good deal of variation in the strength of the central carina, which in some specimens (Station 6) is abnormally wide. At several stations, notably Station 4, specimens exhibit (1) a basal cleft separating the carinae on each side of the shell, (2) an umbo or boss in this cleft, (3) more rarely, a short projecting basal tube.

164. *Lagena ornata* (Williamson).

Entosolenia marginata, var. *ornata* Williamson, 1858, RFGB, p. 11, pl. i, fig. 24.

Lagena ornata Heron-Allen & Earland, 1913, CI, p. 88, pl. vii, fig. 8.

Stations 2, 4.

Very rare at Station 2, but several very well-marked individuals at Station 4.

165. *Lagena lagenoides* (Williamson).

Entosolenia marginata, var. *lagenoides* Williamson, 1858, RFGB, p. 11, pl. i, figs. 25, 26.

Lagena lagenoides Reuss, 1862, FFL, p. 324, pl. ii, figs. 27, 28.

Lagena lagenoides Balkwill & Millett, 1884 & 1908, FG, p. 82, pl. ii, fig. 11.

Stations 2, 4.

Very good specimens are not infrequent at these stations, especially at Station 4.

Sub-Family—Nodosarinæ.

NODOSARIA Lamarck.

166. *Nodosaria communis* d'Orbigny.

Nodosaria (Dentalina) communis d'Orbigny, 1826, TMC, p. 254, No. 35.

Nodosaria communis Reuss, 1845-6, VBK, pt. i, p. 28, pl. xii, fig. 21.

Nodosaria communis Heron-Allen & Earland, 1915, FWS, p. 256, pl. xlii, figs. 1, 2.

Stations 1, 2, 4, 6, 8.

Rare and weak. At Stations 1 and 8 single specimens with abnormal (double or distorted) primordial chambers. At Station 2 the only specimen was of the vaginuline form which we figured from West Scotland (*ut supra*).

167. *Nodosaria pyrula* d'Orbigny.

Plate V, fig. 71.

Nodosaria pyrula d'Orbigny, 1826, TMC, p. 253, No. 13.

Nodosaria pyrula Brady, 1884, FC, p. 497, pl. lxii, figs. 10-12

Stations 2, 4, 6.

Magnificent specimens (one of which we figure) at Station 2. In the inflated chambers they approach *N. soluta* Reuss, but the long pointed primordial chamber establishes their identity as *N. pyrula*.

Length : 2.25 mm.

168. *Nodosaria scalaris* (Batsch).

Nautilus (Orthoceras) scalaris Batsch, 1791, CS, p. 2, pl. ii, fig. 4.

Nodosaria scalaris Cushman, 1910, etc., FNP, 1913, p. 58, xxiv, fig. 7.

Stations 2, 4, 6, 8.

Weakly developed and rare except at Station 4.

169. *Nodosaria obliqua* (Linné).

Nautilus obliquus Linné, 1767, SN, p. 1, 163, No. 281 ; 1788, SN, p. 3372, No. 14.

Nodosaria obliqua Cushman, 1910, etc., FNP, 1913, p. 59, pl. xxv, fig. 5.

Station 4.

One broken specimen only.

LINGULINA d'Orbigny.

170. *Lingulina carinata* d'Orbigny.

Lingulina carinata d'Orbigny, 1826, TMC, p. 257, No. 1, Modèle No. 26.

Lingulina carinata Williamson, 1858, RFGB, p. 14, figs. 83-85.

Lingulina carinata Sidebottom, 1904, etc., RFD, 1907, p. 3, pl. i, figs. 15-17.

A single specimen from Station 4. It is small, with three chambers only of equal dimensions and parallel sides, very like Sidebottom's figure 17 (*ut supra*). Williamson records that he found a specimen of this species "in sand dredged up for me in Plymouth Sound by Mr. S. Bate of Plymouth."

171. *Lingulina biloculi* Wright.

Lingulina carinata, var. *biloculi* Wright, 1910-11, ECM, p. 13, pl. ii, fig. 10.

Lingulina biloculi Heron-Allen & Earland, 1913, CI, p. 94, pl. viii, figs. 5-7.

Station 4.

Two specimens only.

ORTHOCERINA d'Orbigny.

(Synonyms : *Triplasia* Reuss 1853, *Rhabdognonium* Reuss 1860.)

172. *Orthocerina bicamerata* sp. nov.

Plate III, fig. 43.

Test minute, glassy, triangular in section, bluntly pointed at base, but rounded at oral extremity. Consisting of two or rarely three chambers only, with blunt thickened edges. The septal line is slightly depressed on the faces of the shell, but does not extend through the marginal edge. Aperture

central, simple, furnished with a short entosolenian tube which is not readily detected, as it falls in line with the thickened edge when the specimen rests on one of its faces.

Dimensions : length 0.16 mm. ; breadth 0.12 mm.

The foregoing is a description of a single specimen from Station 4. It was at first regarded as a trigonal specimen of *Lingulina quadrata* H.-A. & E., to which it bears considerable resemblance in side view. Mr. E. Milton, of Babbacombe, has, however, found the organism in considerable numbers in shore sands from Torbay, including three chambered specimens. Moreover, *Lingulina quadrata* has not so far been discovered at Plymouth. We must therefore conclude that the organism represents an undescribed species, although it has already been figured by Balkwill and Wright (B. & W., 1885, DIS, p. 344, pl. xii, figs. 17, 18) under the name “? *Rhabdogonium tricarinatum* d'Orbigny sp.” They remark : “This is one of many rare things which have been met with at Lambay, depth 45–50 fathoms. It is interesting to note that the six or seven specimens found were restricted to two chambers, whilst well-grown examples of this species usually have six or seven chambers. We have therefore recorded this provisionally.”

Orthocerina bicamerata is probably widely distributed round the British coast, as, in addition to the Plymouth, Torbay, and Irish Sea records, a specimen has been found in a dredging from the North Sea (Fisheries Cruiser “Goldseeker,” Haul 139, Station 5, 58° 26' N. 0° 8' W., depth 132 metres).

The nomenclature of the angular *Nodosarinæ* is very involved. D'Orbigny in 1826 created a subgenus *Orthocerina* for cylindro-conical forms of *Nodosaria* without septal constrictions, but the type species is probably a broken *Clavulina*. Later, in 1839, he expanded his definition to include an angular species, *Orthocerina quadrilatera* from Cuba. This must be regarded as the genotype. Reuss in 1853 created the genus *Triplasia* for some triangular Cretaceous fossils. Later, in 1860, he proposed to substitute *Rhabdogonium* for *Triplasia*, having in the meantime found quadrangular species otherwise referable to *Triplasia*, which he considered a misnomer. Under the Rules of Nomenclature, however, *Triplasia* cannot be suppressed, and, although most authors have followed Reuss, and used his later name, *Rhabdogonium* must be regarded as a synonym of *Triplasia*, and that genus in turn a synonym of d'Orbigny's earlier subgenus *Orthocerina*, which must be raised to generic rank as having no direct connection with *Nodosaria*. Fortunately there are no great number of species to be considered. The most widely distributed form, *Rhabdogonium (Vaginulina) tricarinatum* (d'Orb.), has recently been separated by Cushman on the grounds of its affinity with *Uvigerina* rather than *Nodosaria*, and made the genotype of *Trifarina* Cushman 1923.

There is no recorded form very closely resembling *Orthocerina bicamerata*. There are two fossil species having only a pair of chambers, viz., *Rhabdogonium globiferum* Reuss and *R. pygmaeum* Reuss, but the primordial chamber in each of these is globular, not prismatic as in our species.

It seems probable that all the specimens of *O. bicamerata* hitherto found are megalospheric. The microspheric form remains to be discovered, and may present considerable differences of form.

VAGINULINA d'Orbigny.

173. *Vaginulina legumen* (Linné).

Nautilus legumen Linné, 1788, SN. (ed. xiii), p. 3373, No. 22.

Vaginulina legumen d'Orbigny, 1826, TMC, p. 257, No. 2.

Dentalina legumen Williamson, 1858, FRGB, p. 22, fig. 45.

Vaginulina legumen Brady, 1884, FC, p. 530, pl. lxvi, figs. 13-15.

Stations 2, 5.

Some very fine specimens at Station 2.

174. *Vaginulina linearis* (Montagu).

Plate V, figs. 73, 74.

Nautilus linearis Montagu, 1803-8, TB, Suppl. p. 87, pl. xxx, fig. 9.

Vaginulina linearis Brady, 1884, FC, p. 532, pl. lxvii, figs. 10, 12.

Stations 2, 4.

Much more frequent than the usually commoner species *V. legumen*. We figure an abnormal specimen formed by the fusion of two young individuals.

175. *Cristellaria crepidula* (Fichtel and Moll).

Plate V, fig. 72.

Nautilus crepidula Fichtel & Moll, 1798, TM, p. 107, pl. xix, figs. g-i.

Cristellaria crepidula Heron-Allen & Earland, 1915, FSC, p. 47, pl. vii, figs. 5-10 ; pl. viii, fig. 1.

Stations 2, 4, 5, 7.

Infrequent except at Station 2, where it is frequent and attains a large size and great variety of form. These variations are largely due to the different sizes of the primordial chamber. Microspheric specimens are very rare. The size of the megalosphere varies enormously in different specimens. We referred to these wide variations in our Cornish paper (*ut supra*), and figured an adequate series of them. We now figure an abnormal specimen from the Chaster collection "Off Plymouth," depth unknown. This is not an instance of a double shell arising from the fusing of two young individuals, but a case of fracture and repair. A megalospheric individual has been broken after at least seven chambers had been formed. The broken edges of the damaged chamber have been filled in with shell matter as neatly as if moulded with wax, and the organism has continued its growth to the extent of a

further three chambers set in the same plane, but 180° away from the original axis of growth. The length of the specimen is 1.57 mm.

176. *Cristellaria hauerina* d'Orbigny.

Cristellaria hauerina d'Orbigny, 1846, FFV, p. 84, pl. iii, figs. 24, 25.

Cristellaria hauerina Heron-Allen & Earland, 1915, FSC, p. 47, pl. viii, figs. 2-4.

Stations 1, 2.

Very rare but fine specimens at Station 2. All the specimens are megalo-spheric. The species was first recorded as British (and figured) by us from Mounts Bay (*ut supra*).

177. *Cristellaria gibba* d'Orbigny.

Cristellaria gibba d'Orbigny, 1839, FC, p. 40, pl. vii, figs. 20, 21.

Cristellaria gibba Cushman, 1910, etc., FNP, 1913, p. 69, pl. xxxv, fig. 1.

Stations 2, 6.

Single specimens only.

178. *Cristellaria rotulata* (Lamarck).

Lenticulites rotulata Lamarck, 1804, AM, p. 188, No. 3; 1816, TEM, pl. 466, fig. 5.

Cristellaria calcar Williamson, 1858, RFGB, p. 27, figs. 52, 53.

Stations 1, 2, 4, 8.

Very good specimens at Stations 2, 4.

179. *Cristellaria cultrata* (Montfort).

Robulus cultratus Montfort, 1808-10, CS, vol. i, p. 214, 54° genre.

Cristellaria cultrata Parker & Jones, 1865, NAAF, p. 344, pl. xiii, figs. 17, 18; pl. xvi, fig. 5.

Stations 2, 4, 6.

Very rare and usually very small.

180. *Cristellaria orbicularis* (d'Orbigny).

Robulina orbicularis d'Orbigny, 1826, TMC, p. 288, No. 2, pl. xv, figs. 8, 9.

Cristellaria orbicularis Cushman, 1910, etc., FNP, 1913, p. 67, pl. xxxvi, figs. 4, 5.

Station 2.

Very rare.

Sub-Family—Polymorphininae.

POLYMORPHINA d'Orbigny.

181. **Polymorphina lactea** (Walker & Jacob).

Serpula lactea Walker & Jacob, 1798, AEM, p. 634, pl. xiv, fig. 4.

Polymorphina lactea typica (pars) Williamson, 1858, RFGB, p. 70, pl. vi, fig. 147.

Polymorphina lactea Brady, Parker & Jones, 1870, GP, p. 213, pl. xxxix, fig. 1 (Refs.).

Stations 1, 2, 4, 5, 6, 8.

Common and often very large, especially at Station 2. Fistulose specimens were found at that station.

182. **Polymorphina williamsoni** Terquem.

Polymorphina lactea, var. *oblonga* Williamson, 1858, RFGB, p. 71, pl. vi, figs. 149, 149a.

Polymorphina williamsoni Terquem, 1878, FIR, p. 37.

Polymorphina oblonga Heron-Allen & Earland, 1913, CI, p. 100, pl. viii, fig. 17.

Stations 1, 2, 4, 6, 8 (*New to Britain under this name*).

Williamson's variety has no zoological affinities with *P. lactea*, and it could not be raised to specific rank under Williamson's varietal name, which is preoccupied by *P. oblonga* d'Orb. Terquem renamed it after its author so long ago as 1878, but the alteration seems until now to have escaped the notice of authors, ourselves included.

183. **Polymorphina concava** Williamson.

Polymorphina lactea, var. *concava* Williamson, 1858, RFGB, p. 72, pl. vi, figs. 151, 152.

Polymorphina concava Brady, Parker & Jones, 1870, GP, p. 236, pl. xl, figs. 22 a, b.

Polymorphina concava Heron-Allen & Earland, 1908, etc., SB, 1909, p. 431, pl. xvii, fig. 6.

Stations 1, 2.

A specimen attached to *Miliolina bicornis* at Station 1, and two free specimens from Station 2.

184. **Polymorphina sororia** Reuss.

Polymorphina (Guttulina) sororia Reuss, 1863, FCA, p. 151, pl. ii, figs. 25–29.

Polymorphina sororia Brady, 1884, FC, p. 562, pl. lxxi, figs. 15, 16.

Stations 2, 4.

Rare. Best at Station 4.

185. *Polymorphina gibba* d'Orbigny.

Polymorphina (Globulina) gibba d'Orbigny, 1826, TMC, p. 266, No. 20, Modèle No. 63.

Polymorphina gibba Cushman, 1910, etc., FNP, 1913, p. 85, pl. xli, fig. 4.

Stations 2, 4, 6, 8.

Common. Large specimens at Stations 2, 4, where fistulose individuals also occur.

186. *Polymorphina communis* d'Orbigny.

Polymorphina (Guttulina) communis and *problema* d'Orbigny, 1826, TMC, p. 266, Nos. 14 & 15, pl. xii, figs. 1-4; Modèles Nos. 61, 62.

Polymorphina communis Brady, Parker & Jones, 1870, GP, p. 224, pl. xxxix, figs. 10 a, b.

Stations 2, 4, 5, 7, 8.

Common. Good specimens at most stations, fistulose at Station 4.

187. *Polymorphina oblonga* d'Orbigny.

Polymorphina oblonga d'Orbigny, 1846, FFV, p. 232, pl. xii, figs. 29-31.

Polymorphina oblonga Brady, 1884, FC, p. 569, pl. lxxiii, figs. 2-4.

A few specimens at Station 2.

188. *Polymorphina compressa* d'Orbigny.

Polymorphina compressa d'Orbigny, 1846, FFV, p. 233, pl. xii, figs. 32-34.

Polymorphina compressa Brady, Parker & Jones, 1870, GP, p. 227, pl. xl, fig. 12.

Stations 2, 4, 6, 7, 8.

Frequent and very large at Station 2. Smaller and rarer elsewhere.

189. *Polymorphina rotundata* (Bornemann).

Guttulina rotundata Bornemann, 1855, FSH, p. 346, pl. xviii, fig. 3.

Polymorphina rotundata Cushman, 1910, etc., FNP, 1913, p. 88, pl. xl, fig. 1.

Stations 2, 4.

Attaining a remarkable size at Station 2, and frequently fistulose.

190. *Polymorphina myristiformis* Williamson.

Polymorphina myristiformis Williamson, 1858, RFGB, p. 73, pl. vi, figs. 156, 157.

Polymorphina myristiformis Brady, 1884, FC, p. 571, pl. lxxiii, figs. 9, 10.

Stations 1, 2, 4.

An extraordinary range of form, size and development at Station 4, from specimens in which the costæ are hardly visible to strongly costate and tuberculate individuals.

191. *Polymorphina complexa* Sidebottom.

Polymorphina (?) *complexa* Sidebottom, 1904, etc., RFD, 1907, p. 16, text-figs. 3-7, pl. iv, figs. 1-9.

Polymorphina complexa Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 673, pl. li, figs. 1-3; FSC, p. 48, pl. viii, figs. 5-7.

Stations 2, 4.

A very few small specimens at each station. First recorded as British by us on a single specimen from Mounts Bay (35-40 fms.).

UVIGERINA d'Orbigny.

192. *Uvigerina angulosa* Williamson.

Uvigerina angulosa Williamson, 1858, RFGB, p. 67, pl. v, fig. 140.

Uvigerina angulosa Brady, 1884, FC, p. 576, pl. lxxiv, figs. 15-18.

Stations 1, 2, 4-7.

Frequent except at Station 5. The specimens are small, but present the usual wide range of variation in length and strength of markings.

Family—Globigerinidæ.

We may repeat our observation of 1915 (FSC, p. 49): "The Globigerinidæ are very sparingly represented, and the specimens are uniformly weak and small."

GLOBIGERINA d'Orbigny.

193. *Globigerina bulloides* d'Orbigny.

Globigerina bulloides d'Orbigny, 1826, TMC, p. 277, No. 1; Modèles Nos. 17 and 76.

Globigerina bulloides Brady, 1884, FC, p. 593, pls. lxxvii & lxxix, figs. 3-7 (Refs.).

Stations 2, 4, 6.

Rare. A few specimens at Stations 2 and 6, and fairly frequent at Station 4, exhibiting a wide range of size. An apparently fossil specimen at Station 2.

194. *Globigerina dutertrei* d'Orbigny.

Globigerina dutertrei d'Orbigny, 1889, FC, p. 84, pl. iv, figs. 19–21.

Globigerina dutertrei Brady, 1884, FC, p. 601, pl. lxxxi, figs. 1 a–c.

Station 4.

A few typical specimens only at this station.

195. *Globigerina rubra*, var. *elevata* d'Orbigny.

Globigerina elevata d'Orbigny, 1840, CBP, p. 84, pl. iii, figs. 15, 16.

Globigerina sp. (?) *rubra* Brady, 1884, FC, p. 603, pl. lxxxii, figs. 8, 9.

Globigerina rubra (?) Heron-Allen & Earland, 1913, CI, p. 105 ; 1913, FNS, p. 131, pl. x, figs. 13, 15 ; 1922, TN, p. 191.

Stations 2, 4.

A single specimen at Station 2, and four at Station 4.

CANDEINA d'Orbigny.

Plate IV, figs. 47, 48.

196. *Candeina nitida* d'Orbigny.

Candeina nitida d'Orbigny, 1889, FC, p. 108, pl. ii, figs. 27, 28.

Candeina nitida Millett, 1898, etc., FM, 1903, p. 692, pl. vii, fig. 2.

Station 2 (*New to Britain*).

One small specimen, no doubt due to the drift of Atlantic water into the Channel.

This is the first British record of this species, which is a common constituent of bottom deposits in the West Indies and the warmer parts of the Atlantic. Brady, however, records that it was found by Norman, in a "Valorous" dredging from the N. Atlantic, in "Valorous" Stn. XIV, 55° 10' N. 25° 58' W. (about the latitude of N. Ireland), 1785 fms., Proc. Roy. Soc., 1875, vol. xxv, p. 215.

Family—Rotaliidae.

Sub-Family—Spirillininae.

SPIRILLINA Ehrenberg.**197. *Spirillina vivipara* Ehrenberg.**

Spirillina vivipara Ehrenberg, 1841, SNA, p. 442, pl. iii, fig. 41.

Spirillina vivipara Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 683, pl. li, figs. 19–23.

Stations 1, 2, 4, 6, 7.

Common and frequently very large. Presenting all the usual variations. At Station 2 in many of the specimens the periphery is extended into a flat ring of brown detritus; presumably these specimens were originally sessile, and the ring marks the area of extension of the pseudopodia and feeding activities. At Station 2 one specimen very similar to *S. ornata* Sidebottom (S. 1904, etc., RFD, 1908, No. 13, p. 9, pl. ii, figs. 7, 8) in its depressed cone and limbate sutural line, but without the beaded ornament on that line marking his species.

198. *Spirillina vivipara*, var. *runiana*, var. nov.

Plate IV, figs. 51-53.

Spirillina vivipara Sidebottom, 1904, etc., RFD, 1908, p. 7, pl. ii, figs. 2 a, b.

Spirillina vivipara (transition form) Heron-Allen & Earland, 1915, FWS, p. 268, pl. xlii, figs. 21-25.

Station 2.

We propose this new varietal name for a transition form near *S. vivipara*, recorded as above from the West of Scotland, and occurring with some frequency and highly typical at this station. It is characterised by the angular section of the tube, which is broadest at the base and furnished on the inner and upper margin with a series of solid cusps of shell matter projecting over and embracing the upper surface of the next convolution. These cusps are not raised above the surface of the test, which is flat on both sides. The under-surface shows lines of growth and irregularly disposed tubercles, which, however, are not so prominent as our drawing would suggest.

Diameter up to 0.42 mm.

Very similar specimens were described by Sidebottom from Delos (*ut supra*), as "*S. vivipara*, var." In his text he compares it with the form *S. vivipara*, var. *unilinearis* Jones, Parker & Brady (1866, etc., MFC, p. 289, pl. vi, fig. 22). In the text this figure was referred to as *S. vivipara*, var. *minima*, Schacko (1892, Gielow. Arch. Freund. Mecklenb. Jahrg. xlv. (for 1898), p. 159, pl. o, figs. 4 a-d). Of this range of figures it will be sufficient to say that they represent a scale of increasing divergence from our variety, for, whereas Sidebottom's figure is nearly identical with our specimens, the figure in the Crag Monograph presents many points of difference, and Schacko's figure, to which the Crag species was referred, has hardly any points in common with the Plymouth specimens.

199 *Spirillina obconica* Brady.

Spirillina obconica Brady, 1879, etc., RRC, 1879, p. 279, pl. viii, fig. 27.

Spirillina obconica Heron-Allen & Earland, 1913, CI, p. 108, pl. ix, figs. 8, 9.

Station 2.

Very rare, but excellent specimens.

200. *Spirillina obconica*, var. *carinata* Halkyard.

Spirillina vivipara, var. *carinata* Halkyard, 1889, RFJ, p. 69, pl. ii, fig. 6.

Spirillina obconica, var. *carinata* Heron-Allen & Earland, 1913, CI, p. 108, pl. ix, figs. 6, 7.

Station 2.

Some splendid specimens of this pretty but fragile form.

201. *Spirillina groomii* Chapman.

Plate IV, figs. 49, 50.

Spirillina groomii Chapman, 1900, UCM, p. 259, pl. xv, figs. 1, 10, 11.

Spirillina groomii Heron-Allen & Earland, 1913, CI, p. 107, pl. ix, figs. 2, 3.

Station 2.

The Clare Island specimen was built up of eight convolutions, as compared with Chapman's, which had only four. The Plymouth specimen has seven convolutions. The tube is reniform in section and furnished with a single line of perforations on the superior or convex side of the shell. The inferior or concave side exhibits no perforations. The primordial chamber shows as a raised stud at the centre of the inferior side. The aperture is also very distinct on the inferior side, but is not seen in the superior view.

Diameter : 0.16 mm.

202. *Spirillina limbata*, var. *denticulata* Brady.

Spirillina limbata, var. *denticulata* Brady, 1884, FC, p. 632, pl. lxxxv, fig. 17.

Spirillina limbata, var. *denticulata* Heron-Allen & Earland, 1913, CI, p. 109, pl. ix, fig. 10.

Station 2.

Very rare.

203. *Spirillina margaritifera* Williamson.

Spirillina margaritifera Williamson, 1858, RFGB, p. 93, pl. vii, fig. 204.

None of the Plymouth specimens can be assigned with certainty to Williamson's species, but there is one specimen from Station 2 which is sufficiently near his figure to be mentioned in this paper.

Williamson's species was based upon a single specimen, and the locality

is not given. The type is not among the Williamson slides in the British Museum (Natural History). His single figure shows a tube round in section with four to five convolutions. The last convolution is smooth except for a line of beads running along the sutural line. Similar beads are studded over the surface of the inner convolutions. Presumably both sides of the test were similar.

His description is "Shell consisting of numerous narrow, somewhat convex convolutions. The outer one smooth; the inner ones obscured by numerous projecting tubercles, arranged in one or two series; in some parts these are most conspicuous along the centre of the convolution; in others along the spiral septal lines. Texture hyaline. Diameter $1/50$ " (inch)."

Williamson's species appears frequently in British and other records, but subsequent figures represent a very different form having little resemblance to the original figure. We propose to separate it under the name of *S. wrightii*.

It seems possible that Williamson's species was based upon a starved specimen of the form subsequently described by Brady as *Spirillina tuberculata* (Siddall: Foraminifera of the River Dee, 1878, Proc. Chester Soc. Nat. Sci., p. 49; B, 1879, RRC, p. 279, pl. viii, figs. 28 a, b; B, 1884, FC, p. 631, pl. 85, figs. 12-16; B. & W., 1885, DIS, p. 349), in which case Williamson's name would have priority.

S. tuberculata is stated to have been "first obtained from deep water off Eddystone," and subsequently found on other parts of our coast. We have not met with any British specimens which could be assigned with certainty to *S. tuberculata* as figured by Brady (*supra*) from Challenger specimens. The British specimens recorded do not appear to have been figured.

204. *Spirillina wrightii*, nom. nov.

Plate IV, figs. 54-58.

Spirillina margaritifera Wright, 1877, RFDA, p. 321, pl. xxvi, figs. 12 a, b.

Spirillina margaritifera Terquem, 1875, etc., APD, 1881, p. 110, pl. xiii, figs. 2 a-d.

Spirillina margaritifera Halkyard, 1889, RFJ, p. 69, pl. ii, fig. 7.

Station 2.

Peripheral edge truncate. Test consisting of a flattened tube in three to seven convolutions. Superior face, flat and covered with coarse perforations, sutural line flush but thickened, showing prominently, very occasionally slightly limbate. Inferior face, flat or slightly concave, usually only the last convolution distinctly visible, the rest of the face studded with raised beads obscuring the septal lines.

The species attains a large size at Station 2, where it is frequent. It occurs at many localities in British seas, and probably most, if not all,

British records of *Spirillina margaritifera* subsequent to Williamson should be assigned to *Spirillina wrightii*. We associate the new species with the late Joseph Wright, who first figured the form in Great Britain in 1877.

We illustrate an abnormal specimen of this species which appears to be a distinct case of "plastogamy" as opposed to "budding." It consists of two individuals of approximately equal size which have been joined together base to base, but not in contact, by the deposition of a band of shell matter connecting their basal edges. This band has been subsequently resorbed (not fractured), and through the gap the beaded bases of the two shells can be seen intact. There is no sign of protoplasm or young individuals in the cavity.

Sub-Family—Rotaliinae.

PATELLINA Williamson.

205. *Patellina corrugata* Williamson.

Patellina corrugata Williamson, 1858, RFGB, p. 46, pl. iii, figs. 86-89.

Patellina corrugata Brady, 1884, FC, p. 634, pl. lxxxvi, figs. 1-7.

Stations 1, 2, 4-7.

Most of the specimens are of the round type figured by Williamson, and at Station 2 attain a large size. At several stations occasional specimens occur of oval form.

DISCORBINA Parker and Jones.

206. *Discorbina nitida* (Williamson).

Rotalina nitida Williamson, 1858, RFGB, p. 54, pl. iv, figs. 106-108.

Discorbina nitida Sidebottom, 1904, etc., RFD, 1908, p. 13, pl. iv, fig. 6.

Stations 1, 2, 4-7.

Attains a large size, notably at Stations 2 and 4, where it is very common, and presents all the variations of thickness and peripheral lobulation described in the S. Cornwall specimens (FSC, p. 49). In these gatherings it is rare only at Stations 1 and 5.

207. *Discorbina millettii* Wright.

Discorbina millettii Wright, 1910-11, ECM, p. 13, pl. ii, figs. 14-17.

Discorbina millettii Heron-Allen & Earland, 1913, CI, p. 121, pl. x, figs. 5-7.

Stations 2, 4.

Differs only from *D. nitida* in its beaded base, and is troublesome to separate from that species. We have noted its occurrence at Stations 2, 4, only, but it probably occurs elsewhere also.

208. *Discorbina praegeri* Heron-Allen and Earland.

Discorbina praegeri Heron-Allen & Earland, 1913, CI, p. 122, pl. x, figs. 8-10; 1914, etc., FKA, 1915, p. 692; 1916, FWS, p. 270; 1916, FSC, p. 50.

Stations 1-7.

Common everywhere.

209. *Discorbina vilardeboana* (d'Orbigny).

Rosalina vilardeboana d'Orbigny, 1839, FAM, p. 44, pl. vi, figs. 13-15.
Discorbina vilardeboana Brady, 1884, FC, p. 645, pl. lxxxvi, fig. 12; pl. lxxxviii, fig. 2.

Stations 2, 6.

Specimens referable to this species are very rare.

210. *Discorbina rosacea* (d'Orbigny).

Rotalina rosacea d'Orbigny, 1826, TMC, p. 273, No. 15, Modèle No. 39.
Discorbina rosacea Heron-Allen & Earland, 1913, CI, p. 124, pl. xi, figs. 7-9.

Stations 1-8.

Common everywhere, and variable.

211. *Discorbina mamilla* (Williamson).

Rotalina mamilla Williamson, 1858, RFGB, p. 54, pl. iv, figs. 109-111.
Discorbina mamilla Heron-Allen & Earland, 1913, CI, p. 123, pl. xi, figs. 4-6.

Stations 1-5.

Probably the dominant *Discorbina* at those stations where it occurs. It is easily separable from *D. turbo* by its peripheral margin, which is more or less lobulate. Most numerous at Station 4, but the finest specimens at Station 2. The height of the spire also varies from practically "squat" to highly domed individuals only separable from *D. turbo* by the lobulation of the margin.

212. *Discorbina baccata* Heron-Allen and Earland.

Discorbina baccata Heron-Allen & Earland, 1913, CI, p. 124, pl. xii, figs. 1-3; 1916, FWS, p. 271; 1916, FSC, p. 50.

Stations 2, 5, 7.

Rare. The best at Station 5.

213. *Discorbina planorbis* (d'Orbigny).

Asterigerina planorbis d'Orbigny, 1846, FFV, p. 205, pl. xi, figs. 1-3.

Discorbina planorbis Heron-Allen & Earland, 1913, CI, p. 124, pl. xi, figs. 10-12.

Stations 2, 6.

Only a few specimens found.

214. *Discorbina turbo* (d'Orbigny).

Rotalia (Trochulina) turbo d'Orbigny, 1826, TMC, p. 274, No. 39, Modèle No. 73.

Discorbina turbo Carpenter, Parker & Jones, 1862, IF, p. 204, App. p. 311.

Stations 2, 4, 6.

Frequent and good specimens, the best at Station 4.

215. *Discorbina orbicularis* (Terquem).

Rosalina orbicularis Terquem, 1875, etc., APD, 1876, p. 75, pl. ix, fig. 4.

Discorbina orbicularis Balkwill & Millett, 1884, FG, p. 23, pl. iv, fig. 13.

Stations 1, 5, 7.

Not common, except at Station 5, where excellent specimens occur.

216. *Discorbina globularis* (d'Orbigny).

Rosalina globularis d'Orbigny, 1826, TMC, p. 271, pl. xiii, figs. 1-4, Modèle No. 69.

Discorbina globularis Heron-Allen & Earland, 1914, etc., FKA, 1915, p. 694, pl. li, figs. 36-39.

Stations 1, 2, 4-8.

This species exhibits the widest variation of form from the highly-inflated type with deep umbilical recess, through neatly circular depressed individuals with almost plane bases, to the outspread, thin-keeled, almost squamous form. Strongly limbate individuals at Station 2.

217. *Discorbina mediterraneensis* (d'Orbigny).

Rosalina mediterraneensis d'Orbigny, 1826, TMC, p. 271, No. 2.

Discorbina mediterraneensis Heron-Allen & Earland, 1913, CI, p. 118, pl. ix, figs. 12-14; pl. x, fig. 1.

Stations 1-7.

Most abundant at Stations 4, 5, 6, where it presents every form of variation.

218. *Discorbina irregularis* Rhumbler.

Discorbina irregularis Rhumbler, 1906, FLC, p. 70, pl. v, figs. 57, 58.

Discorbina irregularis Heron-Allen & Earland, 1913, CI, p. 120, pl. x, figs. 2-4

Stations 1, 2.

Rhumbler's species is really a wild-growing condition of *D. mediterraneensis*, to which it bears the same relation as *Truncatulina variabilis* d'Orb. to *Truncatulina lobatula* (W. & J.). Occasional specimens are to be found, but they are uncommon.

219. *Discorbina tuberculata* Balkwill and Wright.

Discorbina tuberculata Balkwill & Wright, 1885, DIS, p. 350, pl. xiii, figs. 28-30.

Discorbina tuberculata Sidebottom, 1904, etc., RFD, 1908, p. 15, pl. v, fig. 5.

Stations 2, 4, 6.

Very rare, but typical.

220. *Discorbina pustulata* Heron-Allen and Earland.

Discorbina pustulata Heron-Allen & Earland, 1913, CI, p. 129, pl. xii, figs. 5-7 ; 1914, etc., FKA, 1915, p. 701, pl. lii, figs. 24-26 ; 1916, FWS, p. 273 ; 1916, FSC, p. 50.

Station 2.

Two specimens only.

221. *Discorbina chasteri* Heron-Allen and Earland.

Discorbina minutissima Chaster, 1892, FS, p. 65, pl. i, fig. 15.

Discorbina chasteri Heron-Allen & Earland, 1913, CI, p. 128, pl. xiii, figs. 1-3.

Stations 4, 6.

A single specimen only at each station ; owing to its size, it may have been overlooked elsewhere. It is of common occurrence round our coast on muddy bottoms.

222. *Discorbina parisiensis* (d'Orbigny).

Rosalina parisiensis d'Orbigny, 1926, TMC, p. 271, Modèle No. 38.

Discorbina parisiensis Wright, 1877, RFDA, p. 105, pl. iv, fig. 1.

Station 7.

One minute specimen only.

223. *Discorbina wrightii* Brady.

Discorbina parisiensis Wright, 1877, RFDA, p. 105, pl. iv, fig. 2.

Discorbina wrightii Brady, 1881, HNPE, p. 104, pl. ii, fig. 6.

Discorbina wrightii Heron-Allen & Earland, 1913, CI, p. 131, pl. xii, fig. 4.

Stations 2, 4.

Good specimens are not uncommon.

224. *Discorbina tabernacularis* Brady.

Plate IV, figs. 59-61.

Discorbina tabernacularis Brady, 1879, etc., RRC, 1881, p. 65.

Discorbina tabernacularis Brady, 1884, FC, p. 648, pl. lxxxix, figs. 5-7.

A single specimen, which we figure, from Station 5. Its general form and structure agree sufficiently well with the type to justify its allocation to Brady's species, but it does not exhibit those superficial rugosities which are shown in the "Challenger" figures. As, however, the species is normally an inhabitant of tropical waters, the Plymouth specimen may be considered pauperate. According to Brady, its northernmost limit is Cape Verde Islands.

Dimensions: greatest breadth 0.28 mm.; height 0.21 mm.

225. *Discorbina lauriei* Heron-Allen & Earland.

Discorbina tabernacularis Sidebottom, 1910, FRBP, p. 25, pl. iii, fig. 12.

Discorbina lauriei Heron-Allen & Earland, 1924, J. Linn. Soc. (Zool.), vol. xxxv, p. 633, pls. xxxvi-xxxvii, figs. 50-55.

Station 1 (*New to Britain*).

A single specimen. It is flatter and less highly domed than the type, but we have no doubt as to its identity. The species is of frequent occurrence in tropical and subtropical shallow water, but we do not know of its previous discovery north of the Mediterranean, where it was found by Sidebottom at Delos and Palermo.

PLANORBULINA d'Orbigny.

226. *Planorbulina mediterraneensis* d'Orbigny.

Planorbulina mediterraneensis d'Orbigny, 1826, TMC, p. 280, pl. xiv, figs. 4-6, Modèle No. 79.

Planorbulina mediterraneensis Brady, 1884, FC, p. 656, pl. xcii, figs. 1-3.

Stations 1-8.

Common. Large and well-developed specimens nearly everywhere.

TRUNCATULINA d'Orbigny.

227. *Truncatulina refulgens* (Montfort).

Cibicides refulgens Montfort, 1808-10, CS, vol. i, p. 122, 31^{me} genre.
Truncatulina refulgens d'Orbigny, 1826, TMC, p. 279, No. 5, pl. xiii,
figs. 8-11, Modèle No. 77.

Stations 2, 3, 5, 6, 7.

None of the specimens are of any considerable size. Very rare at all the stations, excepting Station 7, where a small and probably young form was common. Its general rarity is rather noteworthy.

228. *Truncatulina lobatula* (Walker and Jacob).

Nautilus lobatulus Walker & Jacob, 1798, AEM, p. 642, pl. xiv, fig. 36.
Truncatulina lobatula Williamson, 1858, RFGB, p. 59, pl. v,
figs. 121-123.

Stations 1-8.

Very common nearly everywhere, and presenting every variation, including, at Station 2, very irregularly grown individuals which had lived in a sessile condition and assumed the form of their environment. Such specimens must not be confused with *T. variabilis* d'Orb., as their spiral growth is normal in spite of their irregular shape. At Station 2 exceptionally high-domed individuals, not to be confused with *T. refulgens*.

229. *Truncatulina variabilis* d'Orbigny.

Truncatulina variabilis d'Orbigny, 1826, TMC, p. 279, No. 8.
Truncatulina variabilis Terquem, 1878, FIR, p. 20, pl. i (vi), figs. 18-25.

Stations 4, 5, 8.

Very rare excepting at Stations 4 and 5, where many specimens could be separated from the deformed *T. lobatula*.

230. *Truncatulina akneriana* (d'Orbigny).

Rosalina akneriana d'Orbigny, 1846, FFV, p. 156, pl. viii, figs. 13-15.
Truncatulina akneriana Brady, 1884, FC, p. 663, pl. xciv, fig. 8.

Stations 1, 2, 3.

Small and rare.

231. *Truncatulina ungeriana* (d'Orbigny).

Rotalina ungeriana d'Orbigny, 1846, FFV, p. 157, pl. viii, figs. 16-18.
Truncatulina ungeriana Brady, 1884, FC, p. 664, pl. xciv, fig. 9.

Stations 1, 2, 3, 5, 7 (FSC).

Rare and very small. The best at Station 5.

292. *Truncatulina pygmaea* Hantken.

Truncatulina pygmaea Hantken, 1875, CSS, p. 67 (*Pulvinulina* in text), pl. x, fig. 8.

Truncatulina pygmaea Brady, 1884, FC, p. 666, pl. xcv, figs. 9, 10.

Station 2 (*New to Britain*).

One small specimen. This is normally a deep-water form, and has not previously been recorded in Great Britain.

SIPHONINA Reuss.

293. *Siphonina tubulosa* Cushman.

Plate IV, figs. 62-64.

Truncatulina reticulata (Czjzek) Brady, 1884, FC, p. 669, pl. xcvi, figs. 5-7 (not 8).

Truncatulina reticulata (Czjzek) Chaster, 1892, FS, p. 60, pl. i, fig. 16.

Siphonina tubulosa Cushman, 1927, Proc. U.S. Nat. Mus., vol. lxxii, p. 10, pl. i, figs. 3, 5.

Stations 2, 4 (*New to Britain under this name*).

The recent specimens figured by Brady (*ut supra*), by Chaster (*ut supra*), and others, under the name of *T. reticulata*, all show characters sufficiently unlike Czjzek's fossil species to justify the new specific name which Cushman has assigned to them in his recently published paper on the genus *Siphonina* and its allies (*ut supra*). The few British recent records of *T. reticulata* (Czjzek) should all be assigned to *Siphonina tubulosa* Cushman.

The species is normally an inhabitant of warmer seas, but occasional specimens have been found all round the south and west coasts of Great Britain.

The Plymouth specimens measure about 0.35 mm. in greatest breadth.

PULVINULINA Parker and Jones.

294. *Pulvinulina repanda*, var. *concamerata* (Montagu).

Serpula concamerata Montagu, 1803-8, TB, Suppl. p. 160 (*vide* Williamson, 1858, RFGB.).

Pulvinulina (repanda, var.) concamerata Cushman, 1910, etc., FNP, 1915, p. 52, pl. xxv, fig. 1.

Station 2.

Five magnificent specimens at this station.

235. *Pulvinulina punctulata* (d'Orbigny).

Rotalia punctulata d'Orbigny, 1826, TMC, p. 273, No. 25, Modèle No. 12.

Pulvinulina punctulata Heron-Allen & Earland, 1913, CI, p. 134, pl. iv, figs. 20, 21.

Stations 2, 4.

Rare and very small.

236. *Pulvinulina concentrica* Parker and Jones.

Pulvinulina concentrica Parker & Jones (MS.), Brady, 1864, RFS, p. 470, pl. xlviii, fig. 14.

Pulvinulina concentrica Brady, 1884, FC, p. 686, pl. cv, fig. 1.

Station 2.

Two specimens only. They are small and weak, but show the characteristic peripheral markings.

237. *Pulvinulina auricula* (Fichtel and Moll).

Nautilus auricula, var. *a*, Fichtel & Moll, 1798, TM, p. 108, pl. xx, figs. *a*, *b*, *c*.

Pulvinulina auricula Brady, 1884, FC, p. 688, pl. cvi, fig. 5.

Station 4.

Curiously rare. Only one large typical specimen such as one might expect to find in such gatherings, and a few small ones.

238. *Pulvinulina haliotide* Heron-Allen and Earland.

Pulvinulina haliotide Heron-Allen & Earland, 1908, etc., SB, 1911, p. 338, pl. xi, figs. 6-11; 1913, CI, p. 136; 1916, FWS, p. 276.

Stations 1-7.

Very fine specimens at Station 2.

239. *Pulvinulina menardii* (d'Orbigny).

Plate V, figs. 65-67.

Rotalia menardii d'Orbigny, 1826, TMC, p. 23, No. 26, Modèle No. 10.

Pulvinulina menardii Brady, 1884, FC, p. 690, pl. ciii, figs. 1, 2.

Station 4.

A single specimen, which we figure. The specimen is small but typical. There are many British records, but no British specimen has hitherto been figured.

Dimensions: length 0.31 mm.; breadth 0.23 mm.; thickness 0.12 mm.

240. *Pulvinulina scitula* Brady.

Pulvinulina scitula Brady, 1882, FKE, p. 716 (not figured).

Pulvinulina scitula Heron-Allen & Earland, 1915, FSC, pp. 51-52, pl. ix, figs. 2-5.

Stations 2, 4.

Extremely rare; only three specimens found. We described at considerable length and figured this species in our Cornwall paper (*ut supra*) as *P. patagonica*, var. *scitula*, having figured it from Clare Island (CI, p. 137, pl. xiii, figs. 5, 6) as *P. patagonica*. There is little or nothing to add to the remarks we made in the Cornwall paper.

241. *Pulvinulina karsteni* (Reuss).

Rotalia karsteni Reuss, 1855, KKM, p. 273, pl. ix, fig. 6.

Pulvinulina karsteni Brady, 1864, RFS, p. 470, pl. xlviii, fig. 15 (after Reuss); 1884, FC, p. 698, pl. cv, figs. 8, 9.

Pulvinulina karsteni Heron-Allen & Earland, 1916, FWS, p. 276, pl. xlii, figs. 34-37.

Stations 2, 6.

One small specimen at each station.

ROTALIA Lamarck.**242. *Rotalia beccarii* (Linné).**

Nautilus beccarii Linné, 1767, SN. (ed. xii.), p. 1162, No. 276.

Rotalia (Turbinulina) beccarii d'Orbigny, 1826, TMC, p. 275, No. 42, Modèle No. 74 (*Rosalina*).

Rotalia beccarii Williamson, 1858, RFGb, p. 48, pl. iv, figs. 90-92.

Stations 1-8.

Abundant and well developed, the largest specimens at Station 1.

243. *Rotalia perlucida* Heron-Allen and Earland.

Rotalia beccarii (pars) Balkwill & Wright, 1885, DIS, p. 351.

Rotalia perlucida Heron-Allen & Earland, 1913, CI, p. 139, pl. xiii, figs. 7-9; 1914, etc., FKA, 1915, p. 718; 1916, FWS, p. 277.

Station 4.

A few specimens only, but quite typical.

Sub-Family—Tinoporinæ.

GYPsINA Carter.

244. Gypsina inhaerens (Schultze).

Acervulina inhaerens Schultze, 1854, OP, p. 68, pl. vi, fig. 12.

Gypsina inhaerens Brady, 1884, FC, p. 718, pl. cii, figs. 1-6.

Stations 2, 5, 7.

Very abundant in the sessile state on coarser grades of material.

Family—Nummulinidæ.

Sub-Family—Polystomellinæ.

NONIONINA d'Orbigny.

245. Nonionina depressula (Walker and Jacob).

Nautilus depressulus Walker & Jacob, 1798, AEM, p. 641, pl. xiv, fig. 33.

Nonionina depressula Brady, 1884, FC, p. 725, pl. cix, figs. 6, 7 (Refs.).

Stations 1-8.

Very common and attains large dimensions at Stations 1, 8.

246. Nonionina asterizans (Fichtel and Moll).

Nautilus asterizans Fichtel & Moll, 1798, TM, p. 37, pl. iii, figs. e-h.

Nonionina asterizans Heron-Allen & Earland, 1913, CI, p. 143, pl. xiii, figs. 12, 13.

Stations 1, 2, 4, 6, 7.

The best specimens were at Stations 6, 7 ; otherwise small and weak.

247. Nonionina stelligera d'Orbigny.

Nonionina stelligera d'Orbigny, 1839, FIC, p. 128, pl. iii, figs. 1, 2.

Nonionina stelligera Heron-Allen & Earland, 1916, FWS, p. 280, pl. xliii, figs. 8-10.

Stations 2, 4.

Rare, but some good specimens at Station 4.

248. Nonionina umbilicatulula (Montagu).

Nautilus umbilicatululus Montagu, 1803-8, TB, p. 191 ; Suppl. p. 78, pl. xviii, fig. 1.

Nonionina umbilicatulula Brady, 1884, FC, p. 726, pl. cix, figs. 8, 9.

Station 2.

A single specimen only. Its absence is no doubt due to the shallowness of the water from which our gatherings were obtained. It is widely distributed round the British coasts.

249. *Nonionina boueana* d'Orbigny.

Nonionina boueana d'Orbigny, 1846, FFV, p. 108, pl. v, figs. 11, 12.

Nonionina boueana Brady, 1884, FC, p. 729, pl. cix, figs. 12, 13.

Stations 1, 6.

Very rare—a few specimens only at each station—but quite typical.

250. *Nonionina pauperata* Balkwill and Wright.

Nonionina pauperata Balkwill & Wright, 1885, DIS, p. 353, pl. xiii, figs. 25, 26.

Nonionina pauperata Heron-Allen & Earland, 1908, etc., SB, 1911, p. 342, pl. xi, figs. 16, 17.

Stations 2, 4, 5, 7.

Large specimens at Station 2, one being the largest we have ever seen; much smaller elsewhere.

251. *Nonionina turgida* (Williamson).

Rotalina turgida Williamson, 1858, RFGB, p. 50, pl. iv, figs. 95–97.

Nonionina turgida Cushman, 1910, etc., FNP, 1914, p. 29, pl. xv, fig. 3.

Station 2.

A single specimen only, very long and narrow in the oral face as compared with the type.

NONIONELLA Cushman.

Plate V, figs. 68–70

252. *Nonionella auricula* sp. nov.

Test free, very hyaline and thin-walled, compressed. Consisting of a variable number of chambers, embracing, rapidly increasing in size and coiled in an inaequilateral spiral, all the chambers, up to thirteen in number, being visible on the dorsal side, while the last convolution only, containing seven to nine chambers, is visible on the ventral or umbilical side. Aperture a fissure on the inner edge of final chamber. Periphery rounded, sutural lines flush in early growth, becoming depressed in final chambers.

Length 0.18–0.25 mm.; breadth 0.14–0.16 mm.; thickness 0.12 mm.

Only a few specimens were found at Station 4. It is noticeable owing to

the brilliant transparency of the shell. Its noarest ally appears to be *Valvulina oblonga* d'Orb. (d'O, 1889, FIC, p. 136, pl. i, figs. 40-42), from which it differs in its fewer chambers and less prominent umbilical flap. The latter feature is almost absent in the British species, which, apart from its inaequilateral aspect, might readily be taken for a pauperate *N. grateloupi* d'Orb. or for *N. turgida* (Will.).

The genus *Nonionella* was instituted by Cushman in 1926 (Cont. Cushman Lab. Foram. Res., vol. 2, p. 64), supplementing *Nonionina*. It includes those species having inaequilateral tests due to the chambers developing lobed extensions on the ventral side at their umbilical end which cover the umbilicus itself. It is questionable whether the genus has biological significance, because the formation of inaequilateral tests is a common feature of variation in many species of *Nonionina*, but for systematic purposes *Nonionella* is useful for the separation of species which are normally asymmetrical.

POLYSTOMELLA Lamarck.

253. *Polystomella faba* (Fichtel and Moll).

Nautilus faba Fichtel & Moll, 1798, TM, p. 103, pl. xix, figs. a-c.

Polystomella faba Heron-Allen & Earland, 1916, FWS, p. 281, pl. xliii, figs. 11-19.

Stations 2, 4.

Good specimens at Station 4. Previously recorded by us as British in FWS (*ut supra*) and FSC, p. 53.

254. *Polystomella striato-punctata* (Fichtel and Moll).

Nautilus striato-punctatus Fichtel & Moll, 1798, TM, p. 61, pl. ix, figs. a, b, c.

Polystomella striato-punctata Brady, 1884, FC, p. 733, pl. cix, figs. 22, 23 (Refs.).

Stations 1-8.

Presenting all the usual variations.

255. *Polystomella striato-punctata*, var. *selseyensis* Heron-Allen and Earland.

Polystomella striato-punctata Heron-Allen & Earland, 1908, etc., SB, 1909, p. 695, pl. xxi, fig. 2. Ditto var. *selseyensis*, *ibid.*, 1911, p. 448 (Catalogue); 1913, CI, p. 146; 1914, etc., FKA, p. 733; 1916, FWS, p. 282.

Stations 1, 2, 5, 6, 7.

The best specimens at Station 6, where it is common.

256 *Polystomella subnodosa* (Münster)

Robulina subnodosa Münster, *vide* Roemer, 1838, UNTM, p. 391, pl. iii, fig. 61.

Polystomella subnodosa Reuss, 1855, TNMD, p. 240, pl. iv, fig. 51.

Station 2.

One specimen only.

257 *Polystomella macella* (Fichtel and Moll)

Nautilus macellus Fichtel & Moll, 1798, TM, p. 66, pl. x, figs. e-g.

Polystomella macella Brady, 1884, FC, p. 737, pl. cx, figs. 8, 9, 11 & ? 10.

Stations 1-3, 5-7.

Fine specimens at Stations 1, 3, 7 ; small at the other stations.

258. *Polystomella crispa* (Linné)

Nautilus crispus Linné, 1767, p. 1162, No. 275 ; 1788, p. 3370, No. 3.

Polystomella crispa Lamarck, 1816, etc., ASV, 1822, vol. vii, p. 625, No. 1 (2nd edn. 1845), etc., vol. xi, p. 302).

Polystomella crispa d'Orbigny, 1846, FFV, p. 125, pl. vi, figs. 9-14.

Stations 1-8.

A peculiar interest must attach to the Plymouth examples of this universally distributed species, for it was from the material collected at Station 1 that J. J. Lister made his world-renowned study of its life-history. At this station we found abundant examples of the megalospheric primordial, with one, or sometimes two, succeeding chambers, exactly as figured by him in his Phil. Trans. paper, and in Lankester's " Treatise of Zoology."

PLATE IV.

- Fig. 47.—*Candeina nitida* d'Orbigny. Apical view. × 65.
 Fig. 48.—*Candeina nitida* d'Orbigny. Side view. × 65.
 Fig. 49.—*Spirillina groomii* Chapman. Inferior view. × 150.
 Fig. 50.—*Spirillina groomii* Chapman. Superior view. × 150.
 Fig. 51.—*Spirillina vivipara*, var. *runiana* var. nov. Superior view. × 110.
 Fig. 52.—*Spirillina vivipara*, var. *runiana* var. nov. Inferior view. × 110.
 Fig. 53.—*Spirillina vivipara*, var. *runiana* var. nov. Edge view. × 110.
 Fig. 54.—*Spirillina wrightii* sp. nov. Inferior view. × 48.
 Fig. 55.—*Spirillina wrightii* sp. nov. Superior view. × 48.
 Fig. 56.—*Spirillina wrightii* sp. nov. Edge view. × 48.
 Figs. 57, 58.—*Spirillina wrightii* sp. nov. Two individuals joined in plastogamic union. × 48.
 Fig. 59.—*Discorbina tabernacularis* Brady. Dorsal view. × 110.
 Fig. 60.—*Discorbina tabernacularis* Brady. Ventral view. × 110.
 Fig. 61.—*Discorbina tabernacularis* Brady. Lateral view. × 110.
 Fig. 62.—*Siphonina tubulosa* Cushman. Dorsal view. × 110.
 Fig. 63.—*Siphonina tubulosa* Cushman. Ventral view. × 110.
 Fig. 64.—*Siphonina tubulosa* Cushman. Lateral-oral view. × 110.

PLATE V.

- Fig. 65.—*Pulvinulina menardii* (d'Orbigny). Dorsal view. × 150.
 Fig. 66.—*Pulvinulina menardii* (d'Orbigny). Ventral view. × 150.
 Fig. 67.—*Pulvinulina menardii* (d'Orbigny). Lateral-oral view. × 150.
 Fig. 68.—*Nonionella auricula* sp. nov. Dorsal view. × 110.
 Fig. 69.—*Nonionella auricula* sp. nov. Dorsal (umbilical) view. × 110.
 Fig. 70.—*Nonionella auricula* sp. nov. Anterior-oral view. × 110.
 Fig. 71.—*Nodosaria pyrula* d'Orbigny. × 33.
 Fig. 72.—*Cristellaria crepidula* (Fichtel and Moll). Monstrous specimen. The upper chambers represent the original shell, the last chamber of which has been fractured and repaired with solid shell substance, growth then being continued by the addition of three chambers at the opposite extremity. × 33.
 Fig. 73.—*Vaginulina linearis* (Montagu). Monstrous specimen formed by fusion of two individuals. × 85.
 Fig. 74.—*Vaginulina linearis* (Montagu). Same specimen viewed from another angle. × 85.

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* This paper is variously referred to as being dated 1849 and 1850. It was read in May, 1849, and all the separate copies were dated on a special title-page 1849, but the volume of which it forms part was issued in 1850, and is so dated.

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IX.—NOTES ON THE PREPARATION BY CHEATLE'S METHOD
OF THIN MICROSCOPE SECTIONS OF WHOLE ORGANS
EMBEDDED IN PARAFFIN.

A TECHNICAL STUDY.

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(Read January 15, 1930.)

ONE PLATE.

THE advantage of large sections is obvious. They afford a panoramic picture of the histological variations which are present in a large plane of tissue. Such variations as exist are usually present in a variety of stages. The progression from the normal to the abnormal may all be observed if the plane of section covers a sufficiently large area. Lesions may be examined both at their centres and at their advancing edges. A statistical survey of considerable magnitude may be possible on one and the same large section. The only large sections usually available are those cut either by freezing or celloidin methods. The sections which could thus be obtained are of considerable thickness, and are only suitable for naked eye or low-power examination. Some years ago, however, Sir G. Lenthal Cheatle (1896) demonstrated to this Society his method of cutting large paraffin sections. He was also good enough to demonstrate this technique to the late Dr. Dawson, to whom I am indebted for many valued suggestions. By means of the large microtome manufactured by the Cambridge Instrument Company, sections measuring $4\frac{1}{2} \times 2$ inches and of a thickness of 6μ to 10μ may readily be obtained with practice. Sections as large as 6×5 inches have been cut at 10μ . The mounted sections are of uniform thickness, and may be examined by high powers of magnification; even up to the oil-immersion lens. They can also be used for naked eye or hand lens inspection, and they may be projected on to the screen by the lantern or the epidiascope. The principles of technique involved in their preparation do not differ essentially from those commonly applied in the case of ordinary small sections. It is only when one comes to carry the recognised methods of technique into practice that difficulties

arise. Refinements of procedure are necessary. What suffices for small pieces of tissue is not sufficient when dealing with tissues or organs of large volume. For example, the penetration of a large mass of tissue by a fixative or other fluid could certainly be achieved by ordinary methods of procedure, but the time occupied would be so great that hardening or other effects might render further operations difficult. It is for reasons such as these that this paper has been compiled. The technique which will be described does not differ generally from that commonly adopted, but at each stage the author has endeavoured to describe in detail such modifications and refinements of technique which seem to him, as the result of experience, to be necessary for the achievement of success.

Fixation.—This may be dealt with as if for an organ removed from the human body. As soon after operation as possible, or, in the case of autopsy, as soon after death as is convenient, the organ or tissue is brought to the laboratory. In the case of an organ like a kidney, injection of the fixing fluid through the renal vessels is a preliminary operation of great value. An organ such as the breast, in which the vessels are awkward to find, is injected with small quantities of fixing fluid in a number of places, which may be as many as fifty, by means of a water-pressure injector or, failing that, a syringe. Great care must be taken, in injecting, to avoid too great pressure, lest a false œdema and separation of the tissues be brought about. When sufficient fluid has been put into the organ, any vessels are ligatured, and the injected organ is placed in a jar of 10 p.c. formol-saline of at least six times the volume of the organ under treatment. If the organ tends to float, it should be covered with a large layer of gauze. In this fluid the organ is left for 24 hours. After the expiration of 12 hours a little 40 p.c. formaldehyde is poured into the dish. This makes up for the weakening of the fixative by the fluids of the tissue. At the end of 24 hours the fixative is changed and allowed to act on the tissue for another 12 hours. Longer fixation does no harm. The organ is only now ready for cutting into slices or bisecting if it be a kidney or breast. This should not be done before fixation. It should be rapidly washed under the tap, when taken out of the fixative, to rid it of excess of formol. The organ is laid on the bench and bisected with a large flat thin knife by a single continuous stroke. This saves knife ridges, should the organ require to be photographed. On either side or on one side of the bisection plane parallel cuts of about half an inch in thickness are made, so that the organ or one-half of it is cut into a series of slices of equal thickness. If only one slice is to be taken through, it should be specially chosen; if all slices are necessary, a tiny cut is made in that side of each slice which has to be uppermost, as an indicator of its ultimate position in block. Each of the slices is placed directly on a sheet of glass, with care that the side to be sectioned is placed downwards on the glass surface. Glass and tissue are then wrapped up in a layer of gauze. This is done in order to ensure a flat surface of the piece of tissue. Should the other slices of the organ not be required at once, they should be placed each

on a glass plate and wrapped in gauze in the manner described. They may then be stored in a jar of fixative for future use.

Dehydration.—For dehydration six large dishes (diameter, 10×6 inches) of dehydrating fluids are necessary. The dishes are best made of glass, for then the progress of the technique can be seen. Flat bottoms to these dishes are necessary, since the tissue is to lie flat throughout the process. Each dish should contain at least six times the volume of fluid for the bulk of the tissue. These dishes should be numbered or labelled respectively formol and spirit 1, formol and spirit 2, methylated spirit 1, methylated spirit 2, absolute alcohol 1, absolute alcohol 2. Each dish should have a glass lid, which is kept firmly down by means of a little vaseline round the rim. The slice of tissue, still wrapped in gauze and on its sheet of glass, is placed in the dish of formol spirit 1, which contains a solution of 10 p.c. formol 1 part and 2 parts of methylated spirit. Here it is left for 24 hours. At the end of that time the tissue is freed from the gauze wrapping and taken off the glass plate. It will be seen that the surface is now perfectly smooth and flat on the side which has to be cut. The tissue is transferred to the next dish of formol-spirit and left there for 12 hours. During that period of time it should be turned over once so that each side gets its proper share of the mixture. The slice of tissue is next placed in the solution of methylated spirit in dish methylated spirit 1, and left there for 12 hours, again turning the slice over once. It is then transferred to methylated spirit 2 and left there for 12 hours. As before, the tissue is turned over once. From the methylated spirit the tissue is taken over into pure alcohol. After taking the slice out of the second methylated spirit jar and before placing it in the first alcohol, both sides of the tissue must be blotted carefully with a clean dry duster. This avoids taking over into the strong spirit any more methylated spirit than is absolutely necessary. The tissue is left in alcohol 1 for 12 hours and turned over as before. A similar period of time and procedure is necessary in alcohol 2. Dehydration is now completed. If dehydration is thoroughly performed, any fat present in the tissues takes on a dead-white waxy appearance in contrast to the surrounding tissues. An extra few hours in the last alcohol is an advantage.

Clearing.—Two dishes (10×6 inches) are required for the removal of alcohol from the dehydrated tissues. The first contains a mixture of equal parts of alcohol and chloroform, the second pure chloroform. (Other clearing agents than chloroform have been recommended by some workers, but in our hands the chloroform method has proved to be the best. In the mixture of chloroform and alcohol the tissue is left for from 4 to 6 hours; and in pure chloroform for 12 hours. In the latter the tissue should become translucent—so translucent, in fact, that if held up to the light, the fatty tissue is almost transparent, while the more solid parts stand out in bold relief.

Impregnation with Paraffin Wax.—As in dehydrating and clearing, the transition of the tissue from one fluid to another must be gradual, so that

untoward shocks to the cellular content are avoided. Accordingly, the next step is to place the now cleared tissue in a dish (10 × 6 inches) containing equal parts of chloroform and hard paraffin at a temperature of 37° to 40° C. for 4 to 6 hours. Then the slice is put into the chamber of a vacuum imbedder containing paraffin wax of melting point 54° C. The vacuumisation which we use is a special one, of gentle continuous suction, actuated by a water-pump. The idea is to avoid too powerful a vacuum, which would cause disintegration of the tissue and too long exposure to heat, which is destructive. The principle involved is not the creation of a vacuum to facilitate entry of paraffin, but of continuous and complete removal of chloroform. The water-pump is started and the tissue is left in the imbedder for 4 to 6 hours. At the expiration of that time the paraffin in the chamber of the imbedder is poured away; it will contain much chloroform. Fresh filtered paraffin is substituted for it. The tissue is subjected for 12 hours to a gentle negative pressure of from 8 to 12 mm., set up by the water-pump. With such a procedure impregnation is successful, and there is no destruction of delicate tissues. The only tissue which we have found requires careful application of a vacuum is brain. In this case a very gentle initial pressure is required, and one has to stand by the imbedder to be ready to cut out the pressure should too vigorous bubbling of the paraffin become apparent. After shutting and opening the valve for some time, however, the delicate brain tissue settles down in the paraffin bath, and more suction may be applied. The paraffin, which is poured away after the initial 4 to 6 hours of impregnating, need not be cast out as useless. It should be placed in a dish and the dish in a water-bath. The chloroform is then driven off by gentle heat. As some of the softer oils in the paraffin will be driven off also, it is advisable to add a little soft paraffin to the recovered wax and exactly an equal portion of new paraffin wax. This wax mixture is melted and filtered. An excellent wax is the result.

Blocking.—At the end of the 12-hour period in the vacuum the tissue is ready for blocking. The pump is turned off; the paraffin in the imbedder is allowed to settle and remain undisturbed for 10 minutes. Bubbles in the paraffin are in this way avoided. A mould sufficiently large to hold the slice of tissue is made with two right-angle brass blocking irons of sufficient depth to project at least $\frac{1}{4}$ inch above the uppermost level of the tissue. Into the mould so arranged fresh filtered paraffin wax is poured almost, but not quite, up to the top, for the tissue itself will displace a good deal of paraffin. A pair of forceps is heated. With the warm forceps the block of tissue is lifted out and very quickly transferred to the paraffin in the mould. After it has been adjusted in the correct position and pressed down gently at several points, it is left till a good skin of hardening paraffin has developed over the surface. The whole is now placed in a sink, and lukewarm water is run in till there is about an inch of water over the surface of the block. It is left till thoroughly hard, which will in all probability require at least an hour. Practical experience has taught us that to place large blocks of

melted paraffin wax in cold water very often causes crystallisation of the paraffin. A slow gradual cooling in a declining heat is ideal, and will consistently give a hardened block of paraffin wax of which the tissue is truly a part.

Preparation of Block for Cutting.—When perfectly cold and hard, the block of wax with its tissue is cut down and trimmed preparatory to fixing on the object-holder of the microtome. With an old razor or knife the two longer sides of the block are trimmed close up to the tissue. The ends are trimmed likewise, with the exception of that end which is chosen to approach the knife first. At least $\frac{1}{2}$ inch of paraffin should extend beyond the tissue at that end. The corners are cut off and the face smoothed down till the tissue almost presents at the surface. Then as much paraffin is cut off from the back as is necessary to make it parallel with the face.

The Microtome.—The Cambridge microtome which we use cuts entirely in one plane; the carriage holding the block moves towards a knife set at right-angles to the direction of movement. In our experience the knife should be set and invariably kept at right-angles to the moving carriage. The knife should be very massive and heavy, flat on both sides, and upon no account hollow ground. The knife clamps must be massive, and exert a powerful and sufficient grip to prevent vibration. The cutting edge should be perfectly parallel to the back, and the blade should not be more than $1\frac{1}{2}$ inch broad. The greatest care should be taken of good knives. After a knife has had a lot of cutting, it should be given a good rest before again being brought into use. When the edge requires grinding, it should be sent to the best cutler available.

Fixation of the Paraffin Block.—One of the medium-sized wooden holders as supplied with the machine is screwed firmly into the metal holder of the microtome. This remains *in situ*, and as time goes on, it will become firmly welded into the brass holder by the accumulations of melted paraffin from many blocks. Sufficient melted paraffin wax to make a thin layer is run on to the face of the wooden block holder. A large flat spatula is heated. The block of paraffin is picked up and held in the left hand close above the surface of the thin layer of wax on the wooden block. The hot spatula is inserted between the block and the wooden support, and passed both over the surface of the wooden block and under surface of the paraffin block. The spatula is withdrawn and the surfaces of heated paraffin are pressed together. A smart blow is now given with the palm of the hand to fix the paraffin block firmly to the support. The spatula is again heated and passed round the sides of the block, so that a firm joint is made. Should the paraffin block project beyond the ends of the wooden block, solid pieces of wax are joined on to the brass block holder and the bottom of the paraffin block. This will ensure perfect solidity of the whole. If it is not solid, and vibration once starts at the front of the block, it will continue its disturbing effect through the entire block. The block and its holder are placed in cold water for a few minutes to cool and harden.

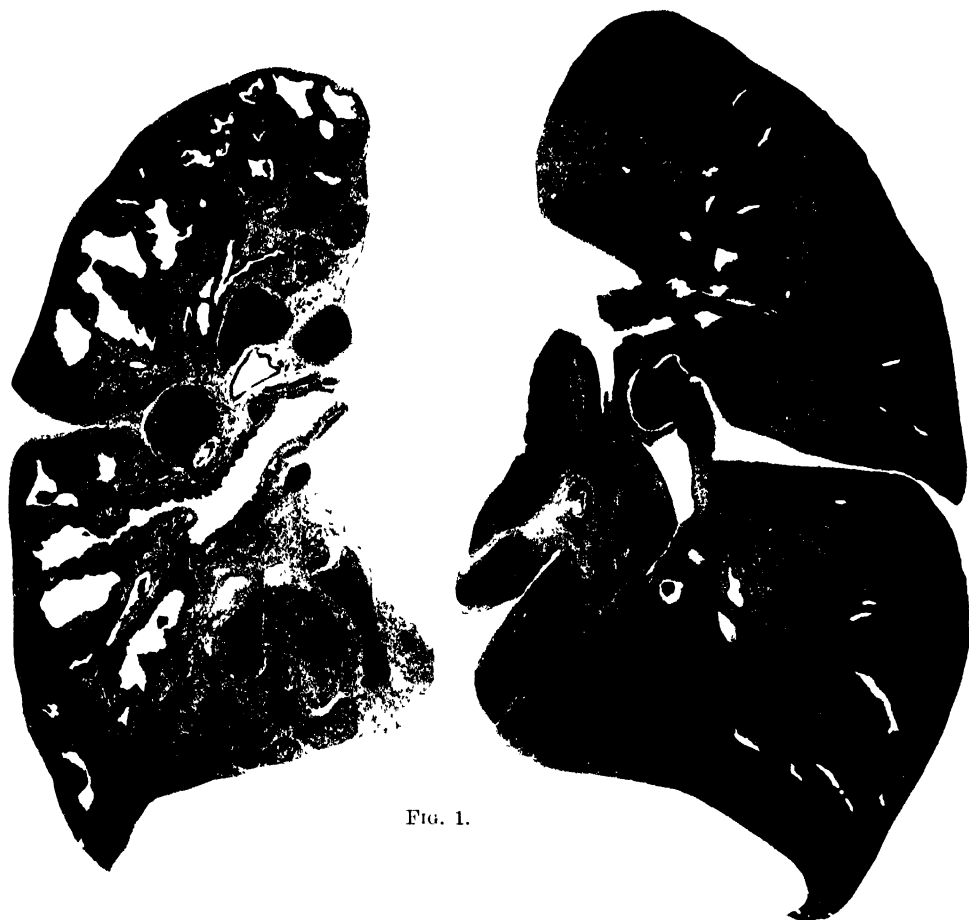


FIG. 1.



FIG. 2.

Cutting.—It will be noticed that the brass object-holder of the Cambridge microtome is fitted with a ball-and-socket joint which, while allowing orientation in different directions, can be rigidly held by the four side-screws. The object-holder with its block is placed in its socket. The block is set squarely on the machine and screwed up firmly. A knife is selected which has already been used for mere trimming down; it is placed in the knife holders and screwed up firmly by means of the six screws. The surface of the block is then trimmed down. To save time, the regulating mechanism is disconnected and the left hand is used to work the screw which pushes up the carriage. The handle is grasped with the right hand and the block is trimmed down. It is best to screw up the block-holder in the first instance to such a level that the wax just clears the knife. The regulating screw should not be turned more than 30μ while trimming down, since imbedded tissue is very easily disturbed by thick sectioning. It is better to take a longer time by cutting thinner sections than to risk disturbing the block and the surface of tissue. The edge of the knife must be cleaned very often with a rag soaked in benzole. When the whole surface of the tissue becomes visible through the paraffin, the block is ready for thin sectioning. It will be noticed that its surface is rather rough. To smooth this, another knife somewhat sharper than the trimmer knife is fitted into the machine, and one or two sections only at 12μ are cut. This will serve to smooth the tissue surface. The surface is gently rubbed with the palm of the hand, and is then ready for the final sectioning. The best knife available is now fitted, and care is taken to ensure that every screw is tight. The regulating mechanism is set to the required thickness, and any variation that may have come about by changing knives is corrected by means of the orientating screws of the block-holder. Cutting with a slow sure motion may now be commenced. It is essential that the carriage travels the whole length of the machine in both directions, so as to permit the automatic dropping and raising apparatus to act. Each stroke is deliberately and evenly made, and, though a bad section is seen to be coming off, the block is taken steadily through in both forward and backward directions. If the sections cut thick and thin alternately, the fault may sometimes be remedied by turning the block-holder slightly round in its socket and setting the knife to the tissue at a somewhat different angle. If, again, the tissue is hard and proves stubborn, the slant of the knife in the clamps is altered. A very little alteration of angle and of slant may make all the difference to successful cutting. During the operation of cutting the surface and edge of the knife are constantly cleaned with benzole, and sometimes the blade is rubbed downwards with the thumb with a firm yet gentle motion. Sometimes the sections come off the knife fairly flat; at others they curl up and come off quill-wise. These latter, however, will be quite satisfactory when uncurled. The sections are laid aside on a clean sheet of paper till ready to mount. When sufficient sections are cut from one block, they are placed in a drawer, free from dust, till cutting is finished. Sectioning is begun

at one end of the knife, which is moved along systematically and bit by bit until the entire length is used up. The knife is stropped frequently during the operations, care being taken to fix it firmly in the knife-holder on each occasion. To hone the knife a Belgian hone is used, and the edge is finished off on an Arkansas stone. Grinding-out of nicks in the edge is best done by an expert cutler; he should be instructed to keep the cutting edge of the blade parallel to the back throughout its length, and on no account to grind away the heel or toe.

Mounting the Sections.—It is best to mount the sections as soon after cutting as possible, to avoid dust and shrinkage of paraffin wax. Pieces of glass as free from blemishes as possible, and somewhat larger than the block of tissue, are selected—old negatives or X-ray plates will do admirably if they are not too thin, since a slide of thin glass of the dimensions required is easily broken. These slides must be very carefully cleaned. This is best done by scrubbing them with a soft nail-brush, using soapy water. Soft soap is excellent. The slide is tested for greasiness by running cold water over it. If grease is present, water will not run over the slide evenly, but will run round the islands formed by grease spots. All grease must be got rid of, or trouble with the fixation of the section to the slide will certainly take place. The washed slides are placed in cold running water till they are required. Sections are best mounted from a glass dish of warm water placed on a bench of dark wood. This facilitates manipulation of the section and allows all its movements to be watched. The dish of warm water, at a temperature that the hand can just bear, is placed on the bench. On one side of it the paper of sections is placed, and on the other the slides which have been put into water of the same temperature as that of the mounting dish. Two slides at the same time are placed vertically in the mounting dish. If the sections which have come off the knife are fairly flat, no difficulty will be found in mounting them. They are dropped gently on to the surface of the water and allowed to flatten out; any small wrinkles are adjusted with the point of the scalpel. The slide is lowered gently under the section, the section is held by the knife in the required position, and the slide removed from the water with the section adhering to it. When the slide is perfectly clean, the section can be manipulated and adjusted with ease. When final adjustment has been made, the section is fixed firmly to the slide by pressing down the paraffin wax of two corners with the finger. The mounted section is then transferred immediately to a hot oven at a temperature of 56°C . It should never be left lying about till another is mounted. Each should be dealt with immediately. The slide is placed in the oven upon its end and at a slight angle. The temperature of this oven will flatten out small and microscopic wrinkles, will free the slide from water, and fix the section firmly. An hour is sufficient for this purpose at this temperature. The slide is then transferred to an incubator at 37°C . till ready to be stained. In dealing with sections which have come from the knife rolled up, the technique of mounting is somewhat different. To unroll

these, the procedure which we adopt is as follows. A slide is laid on the bench and covered with some lukewarm water. The section is laid upon it and gently but firmly coaxed to unroll with a scalpel and a needle; breathing on the section during the process facilitates unrolling. Wrinkles and folds are gently pulled out. There is not the same possibility of pushing the knife or needle through the section while it is on the slide as is easily done while it is on the water of the mounting dish. When made as flat as possible, the slide is picked up with care that the section does not slip off. The water is poured off while the section is kept on the slide with a needle. Slide and section are placed in a mounting dish of warm water. The sections will float, all wrinkles will flatten out, and a perfectly flat section will result. A kettle of boiling water is kept ready, and used, when necessary, to raise the temperature of the water in the mounting dish. Subsequent manipulations are similar to those already described for flat sections. If the slides are perfectly clean, no albumin is necessary in the case of most tissues for fixing the sections to the slides; but for large sections—for example, of the central nervous system—a thin coating of egg albumin is advisable.

Staining.—If the sections are as large as 6×5 inches, not more than one, or at most two, can be stained at the same time. Specially large sections are best treated individually, since they require great care and constant watching. Large dishes are necessarily required for the staining process. These are best made of glass: old museum cylindrical specimen jars are excellent for the purpose. The removal of paraffin wax must be carried through with the greatest care and thoroughness. The sections are placed in benzole for at least half an hour to remove the wax. If two sections are being stained, place them back to back in the benzole cylinder. At the end of half an hour the slides should be taken from the benzole and placed in a cylinder of methylated spirit and washed carefully. Up to this stage two sections can be handled together. After the treatment by methylated spirit, they should be dealt with singly. The slides are removed from the spirit, and a few drops of fresh spirit from a drop bottle are run over the sections. They are then carefully but thoroughly washed in a gentle stream of water. Any surplus water around the section is wiped off and the back of the slide is dried. It is scarcely necessary to point out that in all these manipulations no drying of the section is permissible. The slide is laid on the bench, and a good measure of filtered hæmatoxylin stain is poured over the section. Another section can now be brought to this stage. The stain is removed from the section first dealt with, and, after washing it in water, it is examined under the microscope for depth of nuclear staining. We use a Weigert's iron hæmatoxylin. During decolourisation, if required, the section is examined from time to time under the microscope, and when a satisfactory result has been obtained, it is washed carefully in running water. The slide is now transferred to a large dish of water to which two drops of liq. ammonia fort. have been added, and examined from time to time. When the chromatin elements have taken on a blue-black colour, the section

is washed again in running water to rid it of an excess of alkali. The counter-stain is now filtered directly on to the section. It is washed carefully in methylated spirit, the surplus of spirit is wiped off from the glass with a clean dry towel, and the back of the slide is dried. The section is carefully dehydrated with absolute alcohol from a drop bottle, letting the overflow go into the dish of methylated spirit, and at once placed in another cylinder of benzole. It is now ready for the cover-glass. Cover-glasses of No. 2 thickness are best for the large section. They are not too thin to handle and not too thick to forbid the use of an oil-immersion lens. Great care, however, has to be exercised in cleaning the cover-glasses, since they are easily broken and very expensive. The method which we follow, though very simple, is efficacious, and breakages are very few in number. Two large pads of blotting-paper of about six sheets deep in thickness are prepared and laid flat on the bench. The cover-glasses are cleaned by placing them in the dish of acid alcohol in which the sections were differentiated, and leaving them there for ten minutes. One of the cover-glasses is taken out and transferred to a dish of methylated spirit, and from there to one of the pads of blotting-paper. With a pad of clean dry gauze both sides of the cover-glass are rubbed carefully but firmly. The same process is repeated with another clean dry pad of gauze on another pad of filter paper. In this manner the cover-glass is perfectly cleaned and polished. It is placed in a piece of clean paper and folded up to keep away dust. The requisite number of cover-glasses is thus cleaned. To mount the cover-glass on the section, the cover is laid on the bench, and a long narrow layer of not too thin Canada balsam is placed on it. The slide is taken quickly from the benzole, touched at its lower end with a duster to rid it of superfluous fluid, and lowered gradually from one end to the other upon the cover-glass. The balsam will immediately spread over the section, and the cover-glass will adhere to the slide. The slide is now turned over. A duster is laid over the palm of the open left hand, the slide is laid on the duster, the fingers are gently closed, and the cloth is brought over the edges of the slide so as to absorb any superfluous benzole and balsam. Any large bubbles that may be present are gently pressed out with the duster-covered finger of the right hand. Any excess of balsam will be absorbed by the duster in the left hand and be prevented from going on to the surface of the cover-glass. Very small bubbles may be neglected, as they disappear of themselves. The cover-glass is set evenly and centrally on the slide. Lastly, the section is examined under the microscope to see whether staining has been successful. The slide is then labelled with a glass pencil for identification, laid flat in a drawer free from dust, and left until the balsam has set.

ACKNOWLEDGMENTS.

I desire to express my acknowledgments of helpful criticism and encouragement from Lieut.-Col. A. G. McKendrick, Superintendent of the Laboratory, and to Lieut.-Col. W. F. Harvey, head of the Histological Department.

REFERENCE.

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EXPLANATION OF PLATE.

- Fig. 1.—Slightly reduced. Showing paraffin sections cut at 8μ of whole right and left lungs of a child with pathological changes.
Fig. 2.—Slightly reduced. Showing paraffin section cut at 6μ of whole adult kidney with tumour growth.

X.—ON THE ORIGIN OF YOLK IN THE EGG OF *OSTREA CUCULLATA*.

By HARDIT SINGH RAI, M.Sc.,
Royal Institute of Science, Bombay.

(Read February 19, 1930.)

THREE PLATES.

INTRODUCTION.

ALMOST the whole of our modern knowledge of molluscan oogenesis we owe to Dr. Gatenby and his co-workers. To the best of my knowledge they have worked out the oogenesis of three molluscan forms, *Limnæa stagnalis*, *Helix aspersa*, and *Patella vulgata*. In the centrifuged ovarian oocyte of *Limnæa*, Gatenby (1919) described three layers. The lower layer consisted of a yellow substance which he identified as the mitochondria, and the upper layer of a grey substance which constituted yolk. The middle layer consisted of a clear substance, the hyaloplasm. The Golgi elements remained scattered in the lower layer. In addition to these inclusions, he described a very large number of vacuoles distributed uniformly and giving a frothy appearance to the cytoplasm of the ripe egg. In finished slides the vacuoles were nearly empty. Their contents were considered to be probably watery, but they might have been oily. The vacuoles appeared in the cytoplasm late in oogenesis.

Gatenby and Woodger (1920) summarised their work on molluscan oogenesis as follows :—

“It has been shown that in such a mollusc as *Helix* or *Limnæa* the mitochondria and Golgi elements gradually spread out throughout the oocyte, and the grains forming these systems increase in number. It seems quite probable that the diffuse Golgi elements actually take part in the formation of yolk bodies ; we cannot say so much in the case of the mitochondria. From a study of a number of pulmonate mollusca we have concluded that much of the evidence in these forms is against the view that part of the mitochondrial constituents of the cytoplasm metamorphose into yolk. The latter seems to form either from Golgi elements or *per se* in the ground cytoplasm.”

The above authors also state that in *Patella* “not only do the Golgi elements surpass the mitochondria in their growth activities, but many of

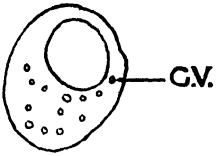


FIG. 1

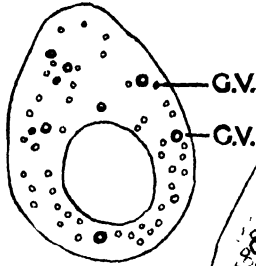


FIG. 2

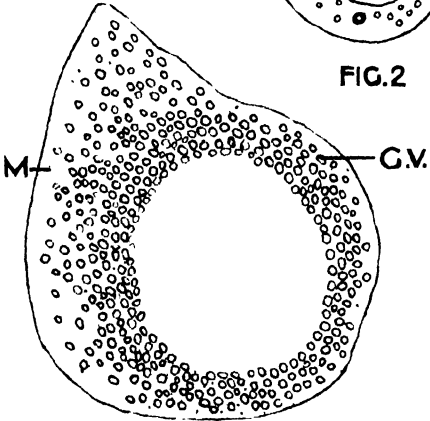


FIG. 4

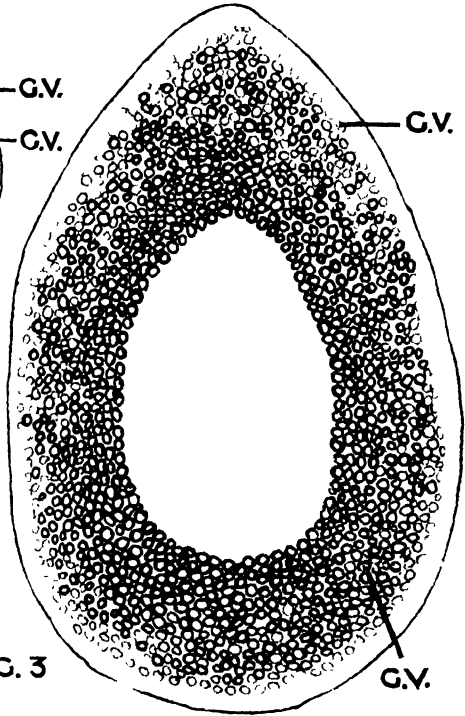


FIG. 3

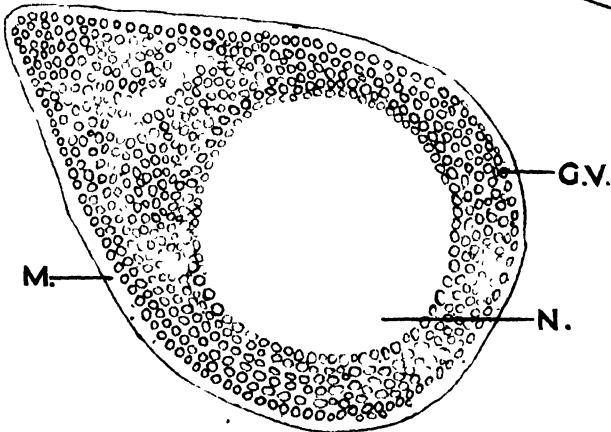


FIG. 5

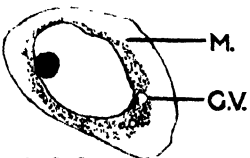


FIG. 6

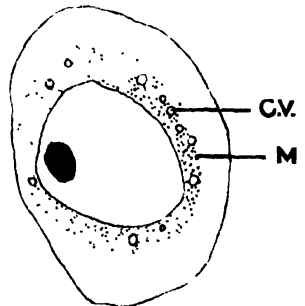


FIG. 7

them become associated in some way with the yolk spheres. This is to say, that however the yolk spheres may be formed, be it from the mitochondria, archoplasm or simply in the ground cytoplasm, the Golgi elements later become stuck upon the surface of many, if not all, of the yolk spheres, and form a most important part of the yolk substance."

Ludford (1921) gave a more detailed account of the origin of yolk in *Patella*, and confirmed the previous account of Gatenby and Woodger. Yolk spheres which were fatty in nature arose by a process of deposition of fat in the archoplasmic (idiozomic) pieces attached to the Golgi batonettes. After the yolk sphere had completed its growth, the Golgi element broke away from it. In other words, the yolk spheres did not arise by a direct metamorphosis of the Golgi elements, but were secretory products thereof. It is, however, very important to note that Ludford, referring to Hirschler's work on the ascidian oocyte, in which the Golgi element is directly converted into yolk, admits that "this also happens to a certain extent in *Patella*. . . ."

The last and perhaps the most important paper of the Gatenby school on the molluscan oogenesis is that of Brambell (1924). Although Brambell confirmed the previous accounts of the indirect origin of the fatty yolk from the Golgi elements in the case of *Patella*, he gave a different account in the case of *Helix aspersa*, inasmuch as the Golgi elements were *directly* metamorphosed into the fatty yolk. Brambell also mentioned that the vacuoles of the egg of *Limnæa* described by Gatenby almost certainly represented the fatty yolk spheres of *Helix* and *Patella* whose contents had been washed out.

From the above summary of the previous account of molluscan oogenesis it is clear that two different processes have been described for the origin of the fatty yolk from the Golgi elements, namely, a direct process (*Helix*) and an indirect process (*Patella*). The present research was undertaken in 1926 to ascertain whether the process of the origin of fatty yolk from the Golgi elements in the oyster egg conformed to the account given for *Patella* (Gatenby and Woodger, Ludford, and Brambell), or to those given for *Helix* (Brambell), *Lithobius* (Nath, 1924), spider (Nath, 1928), *Culex* (Nath, 1929), Ascidians (Hirschler, 1916), *Oniscus* (King, 1926), Scolopendra (Nath and Husain, 1928), the firefly *Luciola* (Nath and Mehta, 1929) and the cockroach (Nath and Piare Mohan, 1929).

MATERIAL AND TECHNIQUE.

The material for this research was obtained from Mahin (Bombay) oyster-beds. After removing the shell the ovaries were dissected out in normal salt solution, and very small pieces were transferred to different fixatives. The Da Fano, Bouin, Champy-Kull and Mann-Kopsch techniques were employed, all of which gave satisfactory results. But by far the most accurate and instructive results were obtained by the study of fresh cover-slip preparations treated for a short time with 2 p.c. osmic acid—a method

which has been extensively used by Nath for eggs of different animals. By this method the Golgi elements can be observed from the youngest to the most advanced oocytes. There is practically no chance of artefacts appearing in this method, for osmic acid used for a short time gives a picture of the cell which is almost like that of the fresh cell. As pointed out by Nath (1928), this view is shared by Strangeways and Canti (1927), who maintain that the cell, after a short period of fixation with 2 p.c. osmic acid, is almost like the living cell *in vitro* with regard to all the inclusions. Another advantage of this method is that one can follow with diagrammatic clearness the fatty and the non-fatty Golgi vesicles. Fresh cover-slip preparations treated with neutral red were also studied, but, as was to be expected, this method did not give any clue to the chemical nature of the contents of the Golgi vesicles.

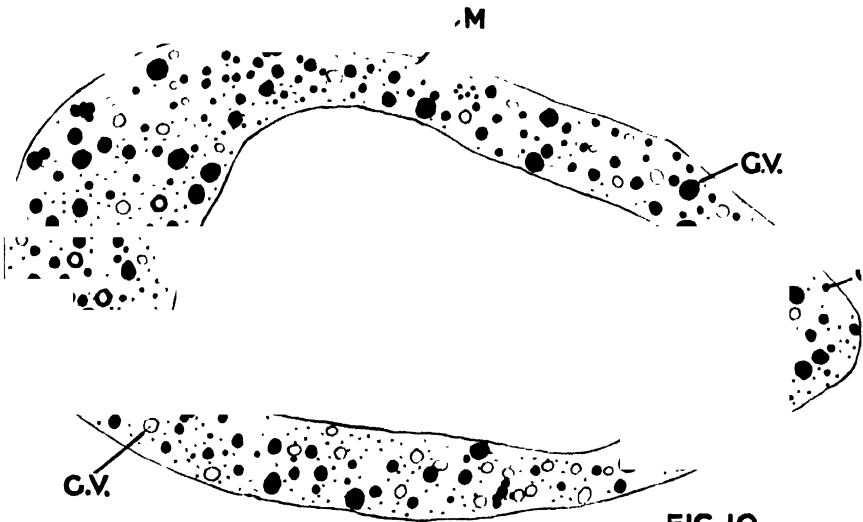
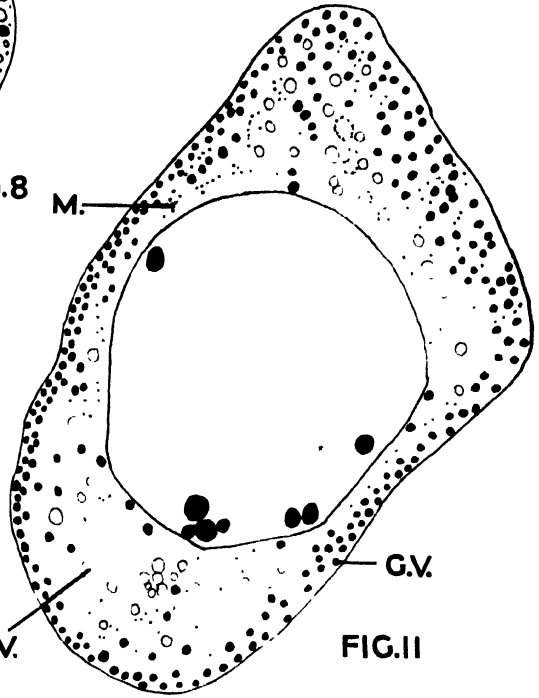
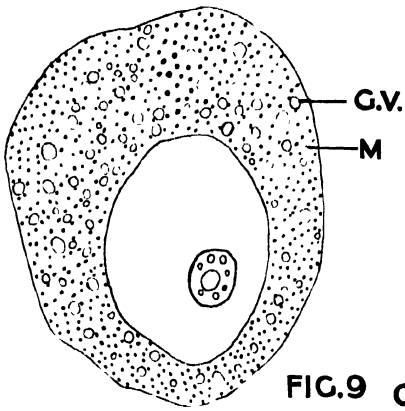
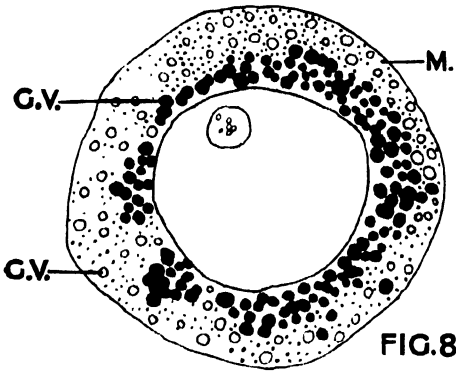
An attempt was made to arrange the different inclusions in strata by means of the hand centrifuge, but it did not succeed, most probably on account of the large nucleus hindering their movement.

The greater part of the present investigation was carried out in the Zoological Laboratory of the Government College, Lahore, under the supervision of Dr. Vishwa Nath, whom I must thank for not only explaining the technique to me, and for studying my slides, but also for the help he has given me in the preparation of the manuscript. I must also thank Professor P. R. Awati, I.E.S., of the Royal Institute of Science, Bombay, for giving me facilities for carrying on a part of this work in the Institute.

OBSERVATIONS.

Fresh Cover-slip Preparations.—When fresh eggs are studied, two types of inclusions can be clearly made out in the cytoplasm, namely, clear spherical bodies and small granular bodies, both distributed in a uniform manner throughout the cytoplasm (fig. 5). As will be shown in the course of the following lines, the former are the swollen Golgi vesicles, and the latter are the mitochondria. Previous immersion of the eggs in watery solution of neutral red does not improve the visibility of these inclusions to any appreciable extent. At any rate, the Golgi vesicles remain almost colourless. In younger eggs (fig. 4) the vesicles are in the act of uniform dispersal.

The study of eggs after about an hour's treatment with 2 p.c. osmic acid very clearly shows the chemical nature of the Golgi vesicles. Fig. 1 represents the youngest oocyte kept in osmic acid for about two hours. The Golgi elements appear as copper-coloured vesicles, and lie quite separately from each other. Whatever else may be the nature of the contents of the vesicles at this stage, they are certainly not fatty. With the growth of the oocyte, not only some of the vesicles grow in size, but their contents also become fatty. In fig. 2 some of the Golgi vesicles (shown as pale rings in the figure) look copper-coloured, while others are blackened by the



osmic acid. These latter are not droplets of fat, but vesicles containing fat inside them. In an advanced oocyte (fig. 8) the majority of the vesicles are blackened by osmic acid on account of the presence of fat inside their interior, while a comparatively few appear copper-coloured.

Fixed Preparations.—The fixed preparations, in spite of certain artefacts which can be easily explained, yield results very similar to those obtained from fresh cover-slip preparations. Figs. 6 to 10 represent unstained preparations of eggs of different stages fixed with Champy-Kull. In the youngest oocyte (fig. 6) the Golgi elements appear as small clear vacuoles scattered among the mitochondrial granules. In reality the number of Golgi vesicles in the youngest oocyte is much larger (*cf.* fig. 1), but in Champy-Kull unstained preparations one can find only a few. The reason for this difference is obvious. The yellowish background offered by the mitochondrial granules facilitates the study of the Golgi vacuoles which are embedded in them, but the vacuoles which are lying outside the mitochondrial area are lost. In fig. 7 there is a larger number of Golgi elements which still appear as clear vacuoles, on account of the absence of any free fat inside their interior. As has already been mentioned, many of the Golgi vesicles grow in size with the growth of the egg, and at the same time free fat is deposited inside their interior (fig. 8). In this preparation the Golgi vesicles arranged round the nucleus appear solid and dull black, while those which are more peripheral in position appear as clear vacuoles. This difference in their appearance may be ascribed to the existence of free fat in the circumnuclear vesicles and its absence in the more peripheral ones. But it may just as well be due to the fact that xylol naturally takes longer time to decolourise osmicated vesicles when they are crowded together, as they are in fig. 8, round the nucleus. Whatever explanation may be accepted, the fact remains that many Golgi vesicles grow in size and store up fat inside their interior. In fig. 9, which represents an egg of the same stage as that shown in fig. 8, all the Golgi vesicles have been decolourised by xylol, and consequently they appear as clear vacuoles. Experience shows that the action of xylol on osmicated fatty bodies is not constant. In a particular egg xylol may decolourise all such bodies, or only a few, or none at all. Fig. 10 represents the most highly advanced oocyte. This preparation is very instructive. Some of the Golgi vesicles appear as clear vacuoles on account either of the absence of fat inside them or of the decolourising action of xylol, others appear solid and dull black, and a few are in the act of decolourisation. These latter show a dull black rim and a light, slightly slaty interior, which is represented in the figure by the white background of the paper. If such a preparation is left in turpentine or xylol for some time, all the Golgi vesicles appear as clear vacuoles, and the egg assumes a frothy appearance.

For the very reason that Da Fano cannot fix fat, it becomes a very useful method for differentiating between fatty and non-fatty Golgi vesicles (fig. 11). The non-fatty Golgi vesicles appear as sharp black granules, due

not only to the blackening of the rim, but also to the excessive precipitation of silver inside their interior. Only some of the fatty Golgi vesicles appear as clear well-defined vacuoles. The others, on account of the failure of this method to coagulate fat, run together in an artificial manner, with the result that irregular empty spaces appear in the cytoplasm, round which the poorly-fixed mitochondrial granules are arranged.

The Mann-Kopsch method is a still more useful method for differentiating between the non-fatty and the fatty Golgi vesicles. Figs. 12 to 15 represent unstained Mann-Kopsch preparations of eggs of different stages treated with turpentine. In the youngest oocyte (fig. 12) the Golgi vesicles appear as sharp black granules on account of excessive osmication. In fig. 13 most of the Golgi vesicles appear granular, but some appear distinctly vesicular, with a sharp black rim and a central light, and slightly slaty interior represented by the white background of the paper. In fig. 14 many of the Golgi vesicles have become fatty, and, as the result of decolourisation with turpentine, they appear as clear vacuoles. The non-fatty vesicles appear either as black granules or as vesicles showing a sharp black osmiophilic rim and a lighter osmiophobic interior. In fig. 15, which represents the most highly advanced oocyte that I have been able to obtain, the number of fatty Golgi vesicles has increased in size. The non-fatty vesicles appear as before, but a few of them show an irregular outline which must be interpreted as an artefact. Such appearances, however, are extremely rare. A somewhat similar artefact was observed by Ludford in *Patella*, where "with 90 p.c. alcohol the yolk spheres underwent a shrinking, so that they appeared like crenulated blood corpuscles."

MITOCHONDRIA.

The mitochondria are of no special interest, and a few words about them will suffice. In the youngest oocytes (figs. 6, 7, 12 and 13) they appear as small granules forming a circumnuclear ring. Gradually they grow in size, and are distributed in a uniform manner throughout the cytoplasm.

NUCLEOLAR EXTRUSIONS.

As in the case of *Patella*, the nucleolus in the egg of the oyster buds off small pieces which migrate into the cytoplasm (fig. 16, Champy-Kull and iron-hæmatoxylin). These extrusions are stained very black, whereas the smaller mitochondrial granules appear grey. Judging from the compound nature of some of these extrusions, it seems likely that they divide in the cytoplasm, but they do not grow in size to any appreciable extent.

DISCUSSION.

In the following lines I do not propose to discuss at length either the behaviour of the mitochondria or the phenomenon of nucleolar extrusions. My work on the oyster confirms the findings of Gatenby and his pupils that

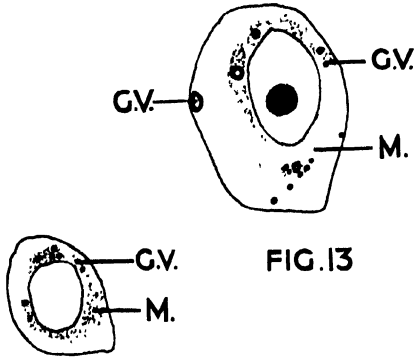


FIG. 13

FIG. 12

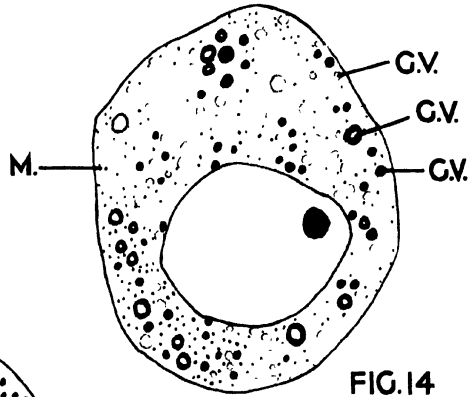


FIG. 14

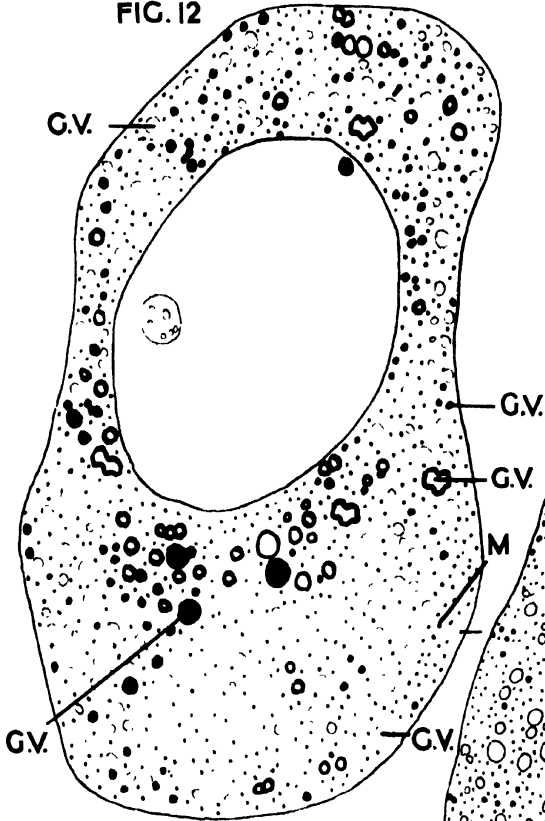


FIG. 15

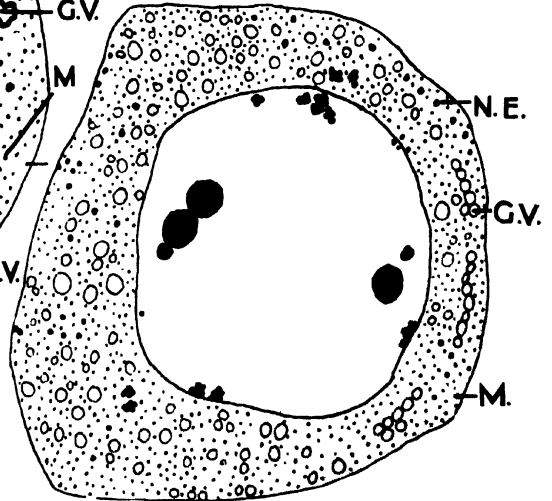


FIG. 16

in *Limnæa*, *Helix* and *Patella* the mitochondrial granules swell up, but they do not in any way contribute towards the formation of yolk which is fatty in nature. Nor do the nucleolar extrusions participate in the formation of yolk. This also is in agreement with the conclusions of Ludford in *Patella*. As a matter of fact, in the egg of the oyster, as also in those of *Limnæa*, *Helix* and *Patella*, there is no albuminous yolk, which, as recent work on some forms has clearly shown, originates from nucleolar extrusions. To quote only a few instances of the nucleolar origin of albuminous yolk, the papers of Gatenby (*Saccocirrus*, 1922), Nath (*Lithobius*, 1924, and *Euscorpius* and *Buttius*, 1925), King (*Lithobius*, 1924), Nath and Mehta (*Luciola*, 1929), Hogben (Cockroach, 1920) and Nath and Piare Mohan (Cockroach, 1929), may be mentioned.

The Golgi elements in the egg of the oyster are vesicular. This has been determined both by the study of fixed and fresh cover-slip preparations. With the growth of the oocyte many of the Golgi vesicles grow in size, store up fat inside their interior and give rise to what, for the sake of convenience, may be termed the fatty yolk, although a study of early organogeny is essential to decide whether the fatty Golgi vesicles are used up as fat or again shrink to their normal size. In other words, fatty yolk arises in the egg of the oyster directly from the Golgi vesicles, as has been shown by Nath and his collaborators in *Lithobius*, spider, *Scolopendra*, *Luciola*, *Culex* and the cockroach, by King in *Oniscus*, by Brambell in *Helix*, and by Hirschler in ascidians. Nath in his papers has emphasised the fundamental morphological similarity between the Golgi elements and the fatty yolk spheres, inasmuch as both of them are vacuolar. This he has determined, not only by the study of fixed preparations, but also by the study of fresh cover-slip preparations either treated with neutral red or with 2 p.c. osmic acid for a short time.

All workers on molluscan oogenesis cited above agree that the fatty yolk is vacuolar in nature. Now, in *Helix*, according to Brambell, the Golgi apparatus in the growing oocytes consists of scattered rod-shaped granules, and they are said to metamorphose directly into vacuoles containing fat. It is difficult to understand how a rod-shaped granule is converted into a vacuole. Similarly, it is difficult to understand how in *Patella* (Ludford) a vacuole could arise from the "archoplasm" of the curved Golgi rods, the Golgi rods themselves breaking away as soon as the metamorphosis of the archoplasm into a vacuole is completed. It is, however, interesting to note that even in *Patella*, according to Ludford, some of the Golgi elements are directly converted into yolk. On the other hand, it seems very likely that study of fresh cover-slip preparations in *Helix* and *Patella* will show, as it has been shown by Nath in many eggs, that the Golgi elements are really vesicular and not "rod-shaped granules" (*Helix*), or "curved rods" (*Patella*)—appearances which very probably are artefacts. The granule is certainly the result of excessive osmication (Parat), while the curved rod or the crescent may either represent optical sections of spheres (Harvey, 1927), or, as has been pointed out by Nath in his paper on *Culex*, may possibly be due to an

incomplete impregnation of the rim of the Golgi vesicle. This difference in details of the origin of fatty yolk from the Golgi elements does not in any way detract from the pioneer nature of the work of Gatenby and his school when it is remembered that fixed preparations only were studied, although Ludford did study apparently advanced living oocytes of *Patella*. It was Gatenby and his pupils who showed practically for the first time that the Golgi elements play some part in the process of vitellogenesis, and Gatenby (1926) has himself pointed out that "reinvestigation of this form (*Patella*), in view of Parat's claims, might yield interesting results."

The most recent remarkable paper of Gatenby (1929) on the "Study of Golgi Apparatus and Vacuolar System of *Cavia*, *Helix* and *Abaxas*, by Intra-Vital Methods," however, has very clearly shown that the differences mentioned above are only apparent and not real. According to Gatenby, there exists in the animal cell a vacuole or system of vacuoles primitively associated with, and probably produced by, the argentophil cortex of the Golgi apparatus. In eggs the vacuole is closely related to the chromophil substance of the Golgi apparatus, where it stores up and lipins. Gatenby is convinced that in such examples of oogenesis as that of *Daphnia* the Golgi element is a cortex on the vacuole, and the division of the element brings about a division of the associated vacuole. Gatenby has also shown that the so-called "archoplasm" or "idiozome," which in many cases appears as the argentophobic part of the Golgi element, is nothing but a collapsed vacuole.

SUMMARY.

1. This investigation is based, not only on fixed preparations, but also on fresh cover-slip preparations either treated with 2 p.c. osmic acid for a short time or with a weak solution of neutral red.

2. Both in the fresh and the fixed preparations the Golgi elements in the youngest oocyte appear in the form of small vesicles. With the growth of the oocyte many of the Golgi vesicles grow in size, store up fat inside their interior, and give rise to the fatty yolk.

3. In the oyster egg the fatty yolk is formed directly from the Golgi vesicles, as in ascidians (Hirschler), *Helix* (Brambell), *Lithobius*, spider, and *Culex* (Nath), *Oniscus* (King), cockroach (Nath and Piare Mohan), *Scolopendra* (Nath and Husain) and *Luciola* (Nath and Mehta).

4. The rod-shaped granules of *Helix* (Brambell) or the curved rods of *Patella* (Ludford) appear to be artefacts, the granule being certainly the result of excessive precipitation of silver or osmium (Parat). The curved rod or the batonette may either represent optical sections of spheres (Harvey), or may possibly be due to an incomplete impregnation of the rim of the Golgi vesicle (Nath).

5. The fundamental morphological similarity between the Golgi element and the fatty yolk sphere is emphasised, inasmuch as both are vesicular in nature.

6. The behaviour of the mitochondria is similar to that described in *Limnæa*, *Helix* and *Patella*. In the youngest oocyte they exist in the form of very minute granules forming a circumnuclear ring. Later they grow in size and are more or less uniformly distributed. They do not take part in vitellogenesis.

7. In the egg of the oyster, as in the case of *Patella* (Ludford), the nucleolus buds off pieces into the cytoplasm.

8. As in the case of *Helix*, *Limnæa* and *Patella*, there is no albuminous yolk in the egg of the oyster.

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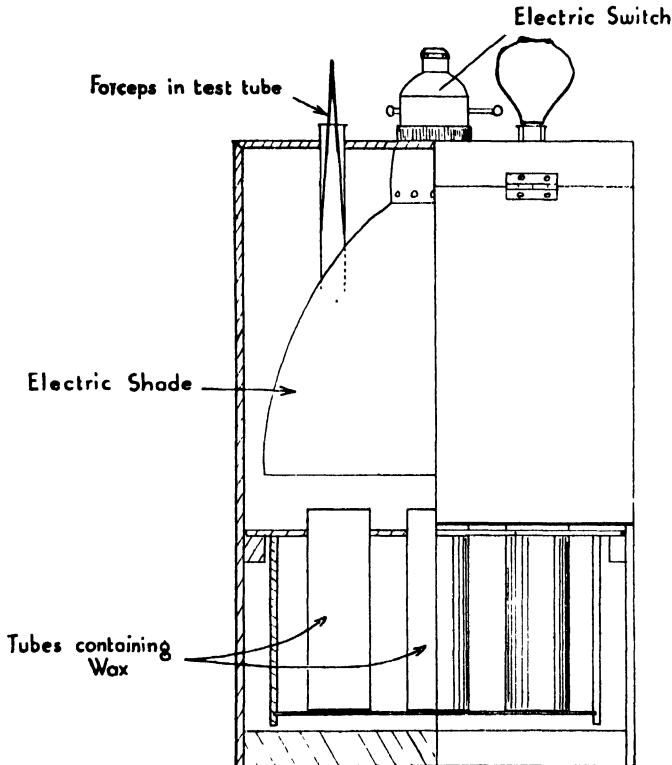
XI.—AN EMBEDDING APPARATUS FOR RESEARCH WORKERS.

By A. CRAIG-BENNETT, Dept. of Zoology, Edinburgh.

(Communicated by A. D. HOBSON, F.R.M.S., April 16, 1930.)

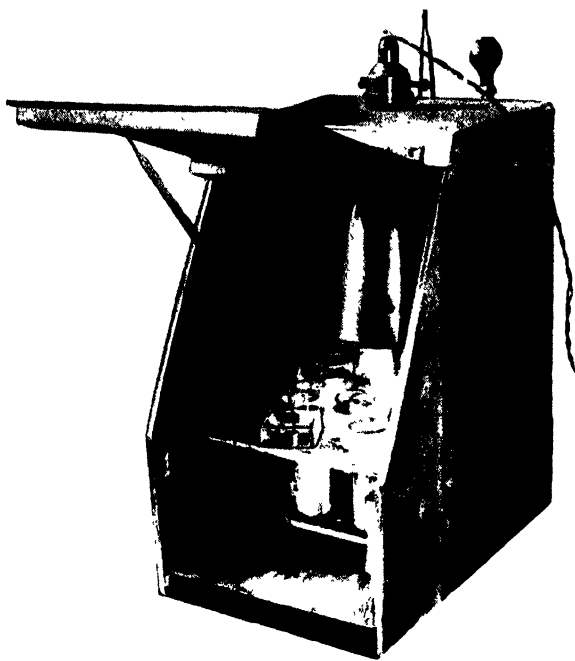
ONE PLATE AND THREE TEXT-FIGURES.

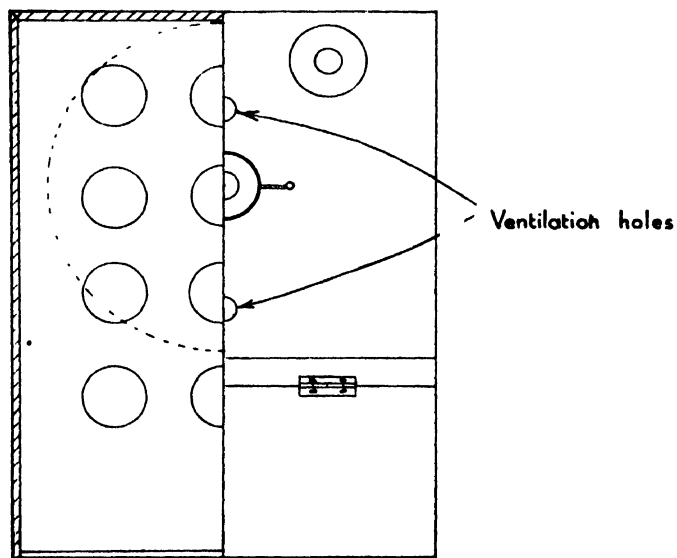
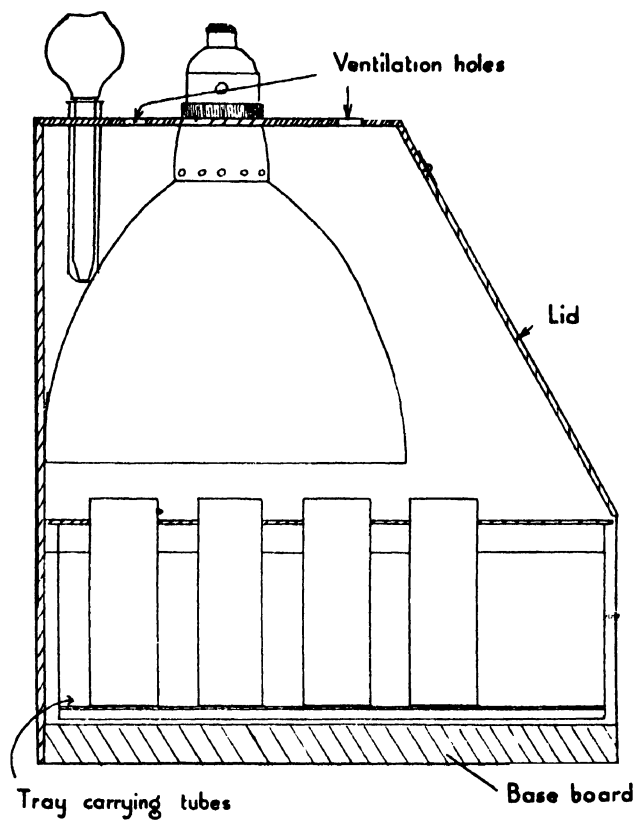
I AM indebted to Prof. McClung for the fundamental principle incorporated in this apparatus. The wax is heated from above, and the heating regulated so that only a part of the wax melts. The object being embedded, being



heavier than the melted wax, sinks to the level of the unmelted part. It is therefore constantly exactly at the melting point of the wax.

The apparatus consists of a 100-watt electric lamp, with a suitable shade, which is placed over a tray carrying a dozen glass tubes ($1\frac{1}{4}$ in. \times 4 in.) containing the wax. This tray is removable. The tubes may contain any wax from melting point 50° C. to 62° C. A convenient arrangement is to





Scale

have the tubes containing different waxes, the melting point of the wax in the tube being written on the tray beside the tube. The watch-glass or other mould used in embedding is placed on the front part of the tray (see photograph), and for the actual embedding, the lid is turned back (it is propped half open in the photograph), and the tray slightly drawn out. The light from the lamp is very useful during the embedding operation. The pipette and forceps are kept at a suitable temperature in glass test-tubes pushed through the lip of the box (see photograph).

In embedding it should be remembered that the wax near the top of the tube is considerably over its melting point, a fact which is frequently useful. If large objects are to be embedded, the glass tubes may be replaced by enamel cups.

The apparatus shown in the photograph is made of wood, without any lining of asbestos, and has been used, without the wood becoming excessively hot, for 24 hours on end. Two $\frac{1}{2}$ -in. holes are made in the top for ventilation, and the lid when closed leaves a gap of 4 in. deep by 7 in. wide. The size of the base is 7 in. \times 11 in., and the height 13 in.

Using the 100-watt lamp, the apparatus should be switched on about ten minutes before use. A lower-power lamp could be used: in this case a rather longer time would be required to melt a sufficient depth of wax for use.

Slides may be dried by removing the tray and placing the slides on the bottom of the box.

In the event of the worker having to suspend operations while the object is still in the bath—a frequent occurrence with teaching research workers—the lamp is switched off; all possibility of damage through the object being “cooked” in the wax is thus simply overcome.

The merits of the apparatus are: the elimination of all possibility of overheating the object, its simplicity and cheapness of construction (the apparatus shown costs five shillings, including the bulb), its cleanliness and economy in use. Its cheapness and simplicity suggest that it will be very suitable for the use of biology masters in schools.

A patent has been applied for.

XII.—A SIMPLE METHOD FOR ESTIMATING “OSMIC ACID,” WITH SOME APPLICATIONS TO CYTOLOGICAL TECHNIQUE.

By RICHARD PALMER, B.Sc., Dept. of Zoology, University College, London.

(Read May 14, 1930.)

ONE TEXT-FIGURE.

OSMIUM TETROXIDE, or “osmic acid,” as its aqueous solution is commonly called, is perhaps the most expensive reagent used by the histologist. Every cubic centimetre of the 2 p.c. solution generally used costs about sixpence. Yet, in the absence of any simple method for the estimation of this substance, it has been the general practice to throw away used solutions, and even to discard stock solutions which have been made up longer than a few weeks. For instance, Bowen (1928) states: “The best plan is to use solutions which are known to have been freshly prepared (within a few days), and in my own work I do not usually use a stock solution which has been made up more than two weeks. Osmic solutions used once should never be used again.” Such advice has the merit of safety, yet it must in many cases involve an unnecessary waste of a very costly reagent. A stock solution may or may not vary significantly over a period of weeks or months, according to the care with which it is handled. If age is the only available criterion, useful solutions must often be discarded. Again, a used solution, provided its strength has not fallen below 1 p.c., can still be employed, after filtration, in a number of fixatives. In Mann’s osmio-sublimate, for instance, 1 p.c. OsO_4 is normally employed; and the same strength can be used in the fluids of Champy, Hermann, Flemming, etc., if the written, though not the actual, formulæ are slightly modified. All that is needed is some simple method by which waste “osmic acid” can be standardised to 1 p.c. It may be noted, in passing, that Bristol (1893) has devised a method of “rejuvenating” waste osmic solutions by the addition of hydrogen peroxide. In view of the well-known fact that impregnation of the Golgi apparatus is inhibited by traces of strong oxidisers, this method can hardly be recommended in the case of solutions to be used for impregnation.

Quite apart from the question of economy, a method for estimating OsO_4 in small quantities would have its uses in cytological technique. The optimum length of time required for the impregnation of any particular

tissue has at present to be determined by trial and error, with consequent waste of time and materials. It is clear, however, that impregnation will be complete, or nearly so, when OsO_4 is no longer being taken up by the tissue, as indicated by the concentration of the supernatant fluid becoming nearly stationary. If this point could be decided by a simple test, a close approximation to the optimum period could be arrived at in the first experiment with new material. Conflicting advice is given by different authorities as to the stage, if any, at which OsO_4 used for impregnation should be changed. Some investigators rely on the degree of blackening of the solution as a criterion of loss of strength. Thus Bowen (1928) states: "My own practice is to pay no attention to the blackening until it becomes sufficiently dark to obscure the pieces of material." On the other hand, Von Bergen (1904) considers that the fluid should be changed as soon as blackening begins. Kolatchev (1916), osmicated for eight days, changes the solution if it blackens before the fourth day, but takes no notice of any blackening which may occur later than this, unless it becomes very intense. As a matter of fact, the degree of blackening is a very unreliable criterion. If the tube is imperfectly stoppered, little or no blackening may occur, though the concentration of OsO_4 has fallen by evaporation to vanishing point. On the other hand, in a well-sealed tube the concentration may not have fallen below 1 p.c., though considerable blackening is apparent. Equally unreliable as a test of the strength of a solution is the presence or otherwise of the smell of OsO_4 . This smell still persists in tightly-stoppered tubes when the actual concentration of OsO_4 in the liquid is less than 0.1 p.c. In short, the only satisfactory way of deciding whether or not a solution requires changing is by a chemical test.

ESTIMATION OF OSMIUM TETROXIDE.

At least three simple qualitative tests for OsO_4 have been described (Singleton, 1927). Of these, the simplest and most convenient for our purpose is that discovered by Tschugaeff (1918) (see also Tschugaeff, 1925). A solution containing OsO_4 , or a chlorosmate, when heated with thiourea in excess and a few drops of hydrochloric acid, gives a clear red colour varying in depth with the concentration of the osmium compound. The test is very sensitive. In an ordinary test-tube the colour is readily detectable when OsO_4 was present in a concentration of 1:100,000.* If the test-tube is examined endwise, the limit of detectability is well below 1:1,000,000. Tschugaeff believes the red substance in question to have the formula: $[\text{Os} \cdot 6(\text{NH}_2 \cdot \text{CS} \cdot \text{NH}_2)] \text{Cl}_3 \cdot \text{H}_2\text{O}$. The presence of chlorine is perhaps rather doubtful, as an identical red colour is produced when HNO_3 is substituted for HCl .

* This and subsequent statements of the OsO_4 concentration of the test mixture express, strictly speaking, the proportion of OsO_4 which would be present if no reaction took place. When the reaction is complete, no OsO_4 is, of course, present.

In the adaptation of this test for quantitative purposes, certain strengths of reagents and methods of procedure were found convenient. A 5 p.c. solution of thiourea in distilled water was used. Concentrated HCl diluted to $\frac{1}{5}$ -strength was employed, though the precise concentration is not significant. The thiourea was added before the HCl, and the liquid heated till boiling, and then allowed to cool for a few minutes. An attempt to use the thiourea and the HCl together as a single reagent was unsuccessful. When this is done, the test occasionally works successfully, but more often a black precipitate appears on boiling.

The test can be made quantitative by the use of a series of standard colour tubes made up by dilution from a solution of known OsO_4 concentration. The range of concentration within which accurate colorimetric judgments can be made lies between 0.01 pc. and 0.001 p.c. A suitable series of colour tubes can be made up as follows :

METHOD.	RESULTING CONCENTRATION.
0.2 ccs. 2 p.c. OsO_4 + 32 ccs. water + 4 ccs. 5 p.c. thiourea + 4 ccs. HCl ($\frac{1}{5}$ conc.) gives 40 ccs. of ..	0.01 p.c.
(1) 5 ccs. of 0.01 p.c.	0.01 p.c.
(2) 4 ccs. of 0.01 p.c. + 1 cc. of water	0.008 p.c.
(3) 3 ccs. of 0.01 p.c. + 2 ccs. of water	0.006 p.c.
20 ccs. of 0.01 p.c. + 20 ccs. of water gives	
40 ccs. of	0.005 p.c.
(4) 5 ccs. of 0.005 p.c.	0.005 p.c.
(5) 4 ccs. of 0.005 p.c. + 1 cc. of water	0.004 p.c.
(6) 3 ccs. of 0.005 p.c. + 2 ccs. of water	0.003 p.c.
20 ccs. of 0.005 p.c. + 20 ccs. of water gives	
40 ccs. of	0.0025 p.c.
(7) 5 ccs. of 0.0025 p.c.	0.0025 p.c.
(8) 4 ccs. of 0.0025 p.c. + 1 cc. of water	0.002 p.c.
(9) 3 ccs. of 0.0025 p.c. + 2 ccs. of water	0.0015 p.c.
(10) 2 ccs. of 0.0025 p.c. + 3 ccs. of water	0.001 p.c.

Care must be taken that all tubes used for this series and for subsequent tests are of the same internal diameter. The tubes are sealed with plasticine. The colour appears to keep perfectly, and is not noticeably affected by light, though it may be advisable to avoid long exposure to sunlight. The only change occasionally noticeable is the appearance of a thin deposit of some white material—possibly excess thiourea—at the bottom of some of the tubes. This does not interfere with the test, and may be disregarded.

The test itself is normally carried out on 0.05 ccs. of OsO_4 solution. Such a small quantity cannot be measured accurately with an ordinary graduated 1 cc. pipette. It is, however, quite easy to make a pipette which yields a drop having a volume of 0.01 cc. A piece of glass tubing with an outside diameter of about 0.4 cm. is drawn out into a rapidly tapering capillary.

The latter is then broken off until the tip is of the right size to yield 100 drops to 1 cc. The pipette is then fitted with a teat or, better, with a short rubber tube with one end closed, and of such length that only a little more than 0.05 cc. of liquid can be taken up. With such a pipette, 0.05 cc. of OsO_4 solution of unknown strength is placed in a test-tube; 8 ccs. of distilled water, 1 cc. of 5 p.c. thiourea and 1 cc. of HCl are then added. The mixture is heated till boiling and allowed to cool for a few minutes. The colour can then be compared with that of the standard tubes. The test mixture is sometimes not quite so clear as the colour standards, and it has therefore to be remembered that it is depth of colour and not darkness that is being judged. It is easier to decide whether one colour is deeper than another than to find the precise position of the test mixture in the range between two colour standards. If, therefore, the judgment first arrived at is at all doubtful, it is advisable to dilute the test mixture to such a degree that its colour should exactly match that of some lower colour standard, if the first judgment was correct. The concentration of OsO_4 in the test mixture is multiplied by 200 to find the concentration of the 0.05 cc. of osmic solution that was tested.

The above test is much simpler in practice than it sounds, and can easily be performed in five minutes. The fact that so small a quantity of solution is necessary is a great advantage, since "osmic acid" is generally used in volumes measuring only a few cubic centimetres.

If the test is only required for the purpose of standardising waste osmic solutions, the procedure can be greatly simplified. Only one colour standard need be made up, namely, that having an OsO_4 concentration of 0.005 p.c. The test is carried out with 0.05 cc. of the filtered waste solution. If the colour of the test mixture is less than that of the colour standard, the waste solution has a strength of below 1 p.c., and cannot be employed in the usual fixatives. If the test mixture is of a deeper colour than the colour standard, it is diluted until the colours match, when the waste stock is diluted to the same extent in order to bring it to 1 p.c. concentration.

It may be mentioned that the test is unaffected by the presence of mercuric chloride, and can therefore be used to test the usefulness of an old osmio-sublimate solution. A black precipitate is, however, produced in the presence of chromic acid, and the test cannot, therefore, be used in the case of mixtures containing this reagent.

THE CURVE OF OSMIC IMPREGNATION.

Using the above colorimetric methods for estimating OsO_4 , an attempt was made to study the changes in concentration of OsO_4 in the supernatant fluid which accompany osmic impregnation. Two pieces, A and B, of frog's kidney were taken. A measured $5 \times 2.8 \times 1.7$ mm., and had therefore a volume of about 24 cub. mm. B measured $3.2 \times 2.4 \times 1.3$ mm., and had a volume of about 10 cub. mm. Each piece was fixed in Mann's

osmio-sublimate for six hours, washed in distilled water and transferred to 5 ccs. of 2 p.c. OsO_4 in an 8 cc. weighing bottle fitted with a ground-glass stopper. Both A and B were kept at an average temperature of 25°C . A control, C, consisting only of 5 ccs. of 2 p.c. OsO_4 , was kept at the same temperature. A similar control, D, remained at room temperature, averaging 15°C . Every day, for a period of eight days, 0.05 cc. of solution was removed from each bottle and its OsO_4 concentration determined. The results are shown in fig. 1, where percentage concentration of OsO_4 is plotted against time. A word of explanation is required with regard to

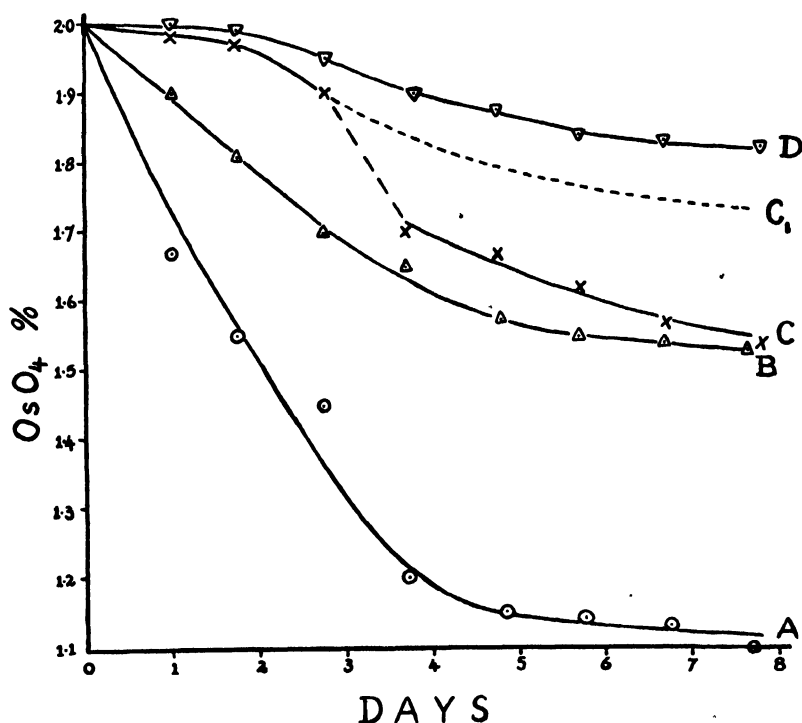


FIG. 1.—A, 24 cub. mms. of frog's kidney at 25°C . ; B, 10 cub. mms. of frog's kidney at 25°C . ; C and C₁, blank control at 25°C . (see text) ; D, blank control at 15°C .

curve C. The sudden fall in the curve during the fourth day was due to a speck of dust which was found in this tube when it was examined towards the end of this day. The slope of this curve between the fourth and the eighth days is undoubtedly exaggerated from the same cause. C₁ is an attempt to represent the probable course of this curve if this accident had not happened. These discreditable facts are only considered worth recording since they illustrate very clearly the need for extreme care in the handling of osmic solutions. Curve D requires little comment. The slight falling off to a concentration of 1.82 p.c. at eight days was, of course, due to the fact that the tube was opened to the dusty air once a day. Curves

A and B are more interesting. Both tend to flatten out during the fifth day, indicating that at this stage osmication was practically complete. This fact lends some support to the shorter periods of osmication advocated by Ludford (1926), though it may be unsafe to generalise too widely from an experiment on one tissue. It may be mentioned that both A and B, when sectioned, showed excellent impregnations of the Golgi apparatus. It will also be noted that there is a rough proportion between the amount of OsO_4 finally taken up and the volume of the piece of tissue.

VESSELS FOR USE IN OSMIC IMPREGNATION.

It has been generally held that glass vessels of small capacity with tightly-fitting ground-glass stoppers are essential for all work involving "osmic acid." To test this assumption, 2 ccs. of 2 p.c. OsO_4 was placed in each of three containers. Of these, A was an 8 cc. weighing bottle with a wide mouth and ground-glass stopper. B was a glass tube with a sound and tightly-fitting cork. C was a glass tube covered with a glass plate. After a week at an average temperature of 25°C ., A had an OsO_4 concentration of 1.35 p.c., B had fallen to 1.1 p.c., and OsO_4 was not detectable in C. It would appear that the prevention of evaporation by proper sealing is more important than the kind of stopper employed. Glass stoppers, provided that they fit tightly, are, however, more effective than cork ones.

The author wishes to express his thanks to Prof. D. M. S. Watson, F.R.S., for his interest, and to Dr. R. J. Ludford, who very kindly read the manuscript.

SUMMARY.

1. A simple method for estimating small quantities of OsO_4 is described.
2. Applications of the method to the standardisation of waste solutions, and to the more accurate control of the process of osmication, are indicated.
3. The results of an experiment on the rate of uptake of OsO_4 by tissues are given.

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

The History of Staining. Anilin Dyes in Histology.—H. J. CONN (*Stain Technol.*, 1930, 7, 3–12). In this section of his study on the history of staining, the use of aniline dyes in histology is discussed, from their first use by Beneke in 1862 down to the beginning of the present century, by which time the general principles attending their employment had been standardised. A very full bibliography is given of the most important papers of outstanding interest. G. M. F.

Hæmatein.—S. I. KORNHAUSER ("Hematein—its Advantages for General Laboratory Usage," *Stain Technol.*, 1930, 7, 13–15). Hæmatein has certain advantages over hæmatoxylin in that it is easy to prepare, easy to use and saves time, while it gives equally good results. Unfortunately it is not easy to obtain a satisfactory sample, but when such has been found, the following method is rapid and satisfactory:—Paraffin or celloidin sections of Bouin or Zenker-formol material are passed down to water and are stained for about 5 minutes in Mayer's hæmalum (0.5 gm. hæmatein ground up in a glass mortar with 10 c.cm. 95 p.c. alcohol and added to 500 c.cm. of 5 p.c. aqueous solution of potassium alum). Rinse 1 to 3 seconds in tap water. Dip 1 to 3 seconds in eosin B (1 part 0.5 p.c. sol. in 20 p.c. alcohol added to 2 parts distilled water: filtered from time to time). Dehydrate and mount. With unattached celloidin sections, this may be done by passing up to 95 p.c. alcohol, spreading on the slide, blotting, wetting with absolute alcohol, draining and mounting in euparal. G. M. F.

A Rapid Paraffin Embedding Method.—L. P. AMBROGI (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 124–5). The method is especially recommended for tissues which get brittle from chloroform treatment. It ensures good penetration for all material except that containing much air, and it is adaptable for all the usual stains. (i) Fix thin slices of tissue (2 to 3 mm.) in 10 p.c. formalin for 6 hours; (ii) wash in running water for 2 hours; (iii) acetone through three changes of $\frac{1}{2}$ hour each; (iv) cedarwood oil from 3 hours or until translucent; (v) paraffin through three changes of 1 hour each. G. M. F.

A Method for the Prevention of Distortion and Hardening of Tissues.—W. F. SHERIDAN ("Use of (A) Normal Propyl Alcohol and (B) Low Melting-point Paraffin in Infiltration to Prevent Distortion and Hardening of Tissues," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 125–6). Normal propyl alcohol is a good dehydrating and clearing agent. The fixed tissue is placed in the propyl alcohol overnight and infiltrated with paraffin the following day. There is a remarkable development and preservation of tissue colours. Uterine fibroids, skin, connective tissue tumours and others undergoing sclerosis are easier

to section when treated with this reagent. It is preferable to use soft paraffin, having a melting-point at 40 to 43° C., for infiltration. After completing the infiltration the material is transferred to hard paraffin (m.p. 52 to 54° C.) for 1 to 2 minutes and embedded.

G. M. F.

The Mechanism of Staining.—A. E. STEARN and E. W. STEARN ("The Mechanism of Staining Explained on a Chemical Basis. II. General Presentation," *Stain Technol.*, 1930, 7, 17-24). At present the division of the factors influencing staining into those supporting a chemical mechanism or those supporting what is known as "adsorption" mechanism is questioned because the latter cannot be definitely defined from general usage. In this paper the nature of adsorption is discussed. Data indicating definitely a chemical mechanism are not directly considered, but in many cases often cited by other writers, as necessitating a non-chemical mechanism, the validity of such mechanism is questioned.

G. M. F.

The Demonstration of Mucin.—R. D. LILLIE ("A Brief Method for the Demonstration of Mucin," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 120-1). The method can be used on material fixed in formalin or in Zenker-Helly. Paraffin sections are passed through xylol and the alcohols to water, then treated with iodine and sodium thiosulphate if the fixative used contained mercury. The sections are transferred to a 2 p.c. aqueous solution of toluidin blue for 1 minute, then washed in water, dehydrated in pure acetone, cleared in xylol and mounted in neutral balsam. Mucin is reddish violet; cell nuclei and bacteria, deep blue; red cells, yellow or greenish yellow; cytoplasm and fibrous tissue, bluish green; thyroid colloid, very pale blue; decalcified bone, light bluish green with pale violet; Sharpey's fibres and cartilage matrix, deep bluish violet; hyaline and amyloid, bluish green, and careous matter pale blue green; coagulated serum, pale greenish blue; muscle light blue, and most cell granules blue violet.

G. M. F.

A Silver Impregnation Method for Neurofibrils.—S. OKADA ("Über eine neue Silberimpregnationsmethode zur Darstellung der Neurofibrillen," *Folia anat. Japonica*, 1929, 7, 403-7). The method is as follows:—(i) Fix thin slices of fresh tissue in the following: Absolute alcohol 80 c.cm., 0.1 p.c. NaOH 20 c.cm., or absolute alcohol 98 c.cm., 1.0 p.c. NaOH 2 c.cm. Wash in distilled water for 5 to 10 minutes. (ii) Transfer to 1.5 p.c. silver nitrate solution for 3 to 5 days at 37° C. or at room temperature. Rinse rapidly in distilled water. (iii) Reduce in the following at room temperature: Formalin 5 c.cm., distilled water 100 c.cm., pyrogallol acid, 2 gm. (iv) Treat as usual, embed in paraffin, cut. (v) Transfer sections to 5 p.c. fixing natron for 5 minutes and rinse in running water for a few hours. (vi) Dehydrate, clear and mount. The neurofibrils should appear black on a light field, as should the pericellular net of the ganglion cells. The glia fibres are not stained.

G. M. F.

Weigert's Elastic Tissue Stain—a Modification.—W. F. SHERIDAN ("Weigert's Elastic Tissue Stain Prepared with Crystal Violet," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 123). The advantage of crystal violet over basic fuchsin in the preparation of Weigert's stain is its definite chemical composition, greater stability, complete selectivity and better differentiation in the presence of blue counterstains. Elastic fibres stain green to greenish black. The method of preparing the stain is as follows: Crystal violet 1.0 gm., resorcin 2.0 gm., distilled water 100 c.cm. Dissolve by boiling for a few minutes, stirring constantly. Add to the boiling mixture 30 c.cm. of a 30 p.c. aqueous solution of ferric chloride. Continue boiling, stirring constantly, for several minutes or until precipitation

ceases. Collect precipitate on the filter and wash with 50 c.cm. of distilled water. Dissolve in 100 c.cm. of absolute alcohol by boiling in a porcelain capsule on a sand bath. Cool, filter, and add 2.0 c.cm. HCl. Stain sections for one or two hours and differentiate in absolute alcohol till elastic fibres alone remain stained. G. M. F.

A New Fixative for Mitochondria.—J. GOUGH and J. D. FULTON (*J. Path. & Bact.*, 1929, 32, 765–9). Mercuric acetate has a definite fixative action on mitochondria. The method is applied as follows:—(i) Fix fresh thin slices of tissue in a neutral formol-saline solution for at least 48 hours. The formol-saline is prepared by adding sufficient magnesium carbonate to render the mixture alkaline, filter, titrate with untreated 10 p.c. formol-saline to pH 7.0. (ii) Wash in running water for 3 hours. (iii) Mordant 48 hours in mercuric acetate 3 gm. acetic acid 0.1 c.cm. distilled water 100 c.cm. (iv) Wash 12 to 18 hours in running water. (v) Treat with 50 p.c. alcohol for 3 hours methyl alcohol overnight, absolute alcohol 3 to 4 hours, equal parts of absolute alcohol and xylol 1 to 2 hours, xylol 1 to 2 hours, paraffin wax 3 to 4 hours. (vi) Stain by Bensley-Cowdry's method, using 6 p.c. acid fuchsin or 0.5 p.c. methyl green. If overstained with the green, differentiate in 50 p.c. alcohol. Heidenhain's hæmatoxylin was also used. Lugol's iodine followed by potassium thiosulphate will remove excessive mercuric acetate, if necessary, before staining with hæmatoxylin. G. M. F.

A Simple Method for Staining Spirochetes.—E. WEISS (*J. Lab. & Clin. Med.*, 1929, 14, 1191–3). The material supposedly containing spirochætes is placed on a slide in a drop of 5 p.c. glacial acetic acid. The slide is inverted over a hollow ground slide and placed in an incubator for 15 minutes. The drop is then spread and allowed to dry in air. The slide is covered with the mordant (100 gm. tannic acid dissolved in 100 c.cm. 95 p.c. alcohol and mixed before use with two parts of 7.5 p.c. glacial acetic acid in undiluted formalin and steamed for 2 to 5 minutes). The slide is then washed with warm water and covered with a saturated solution of a basic dye for 2 to 5 minutes, then washed again and dried in air. If counter-staining is desired, cover with a 10 p.c. solution of contrasting acid dye in 30 p.c. alcohol for 8 to 10 minutes, wash with water and dry. The following combinations of contrasting basic and acid dyes are recommended: crystal or gentian violet with acid green, safranin or fuchsin with acid green, and brilliant green with acid violet or acid fuchsin. G. M. F.

A Rapid Method for the Colouration of Negri Bodies.—G. PETRAGNANI ("Metodi rapidi di colorazione dei corpi del Negri," *Boll. Instit. Sierot Milanese*, 1928, 7, 557–61). The mordant employed is as follows:—Solution I: ground potassium alum (crystalline) 3 gm., lead acetate (crystalline) 0.5 gm., glacial acetic acid 3 drops, distilled water 100 gm.; dissolve on water-bath and mix with Solution II, which consists of tannic acid 7 gm., ferric chloride 2 gm., methyl alcohol (pure) 35 gm., distilled water 15 c.cm. Filter after 2 to 3 days, dilute with 20 to 50 or more volumes of methyl alcohol. Method A (for sections):—After passing through xylol and absolute alcohol, treat for 5 to 10 seconds in dilute mordant, wash rapidly in absolute and 95 p.c. ethyl alcohol; stain for 10 to 20 seconds in eosin (Grübler alcohol soluble, 0.5 gm. in 100 c.cm. 50 p.c. ethyl alcohol); wash slowly in water; stain one minute with Mayer's hæmatoxylin; wash rapidly with water; stain with methylene blue until violet; dry with filter paper; wash and shake 15 to 20 seconds with absolute alcohol containing 0.25 p.c. N/2 NaOH; wash with 90 to 95 p.c. ethyl alcohol until a general blue; two changes of absolute alcohol; xylol; mount in neutral balsam. Stains nerve cells blue, nucleolus dark blue, capillaries with nucleus and endothelium brilliant red, red globules red, Negri

bodies eosin red. **Method B:**—After xylol and absolute alcohol, treat for a few seconds with mordant diluted in 100 to 200 volumes of water; wash with absolute and then 75 p.c. alcohol; stain for 30 seconds with eosin as above or acid fuchsin; wash in water, then in 95 p.c. alcohol; two changes of absolute alcohol; xylol and balsam. Cell bodies are stained pink, Negri bodies brilliant red. **Method C:**—Treat with mordant (1 vol. in 20 to 40 vols. methyl alcohol) 5 to 10 seconds; with acid fuchsin as in Method B for one minute; wash in water; stain with indigo carmine (1 gm. in 500 c.cm. water) for 5 to 20 seconds; wash with water, then 95 p.c. alcohol; two changes of absolute alcohol, xylol, balsam. By this method the indigo carmine partially displaces the acid fuchsin, thus providing a good stain for demonstrating the chlamydozoic structure of Negri bodies. G. M. F.

A Stain for B. lepræ and Myelin Sheath.—H. CAMPBELL (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 129–30). To stain the neurokeratin of myelin sheaths at the same time as demonstrating leprosy bacilli, proceed as follows:—Fix tissue in acetic Zenker; wash; place for 6 to 24 hours in equal parts of 80 p.c. alcohol and Lugol's solution; 80 p.c. alcohol for 12 to 24 hours; 95 p.c. alcohol 2 to 6 hours; absolute alcohol, two changes, 6 to 24 hours; absolute alcohol and xylol (equal parts), $\frac{1}{2}$ hour; xylol, $\frac{1}{2}$ hour; paraffin, two changes, 1 hour. After sectioning and securing the section on the slide, place in xylol to remove paraffin. Stain $\frac{1}{2}$ hour in Kinyoun's carbol fuchsin (basic fuchsin 4 gm., phenol crystals 8 gm., 95 p.c. alcohol 20 c.cm., distilled water 100 c.cm.). Rinse in water; acid alcohol (0.5 p.c. HCl in 35 p.c. alcohol), two changes; do not differentiate completely at this step. Stain in Harris' hæmatoxylin without acetic acid for 2 minutes or less. Differentiate again in the acid alcohol; rinse in water; place in 1 p.c. ammonia water; rinse in water. Counterstain in 1 p.c. aqueous solution of orange G. Dehydrate quickly in two changes of acetone; xylol; mount in xylol-damar or xylol-balsam. The leprosy bacillus and the neurokeratin stain red, nuclei blue, and cytoplasm yellow. G. M. F.

The Decolourization of Tubercle Bacilli in Sections at Low Temperatures.—A. R. HAYTHORN (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 130–4). The sections are stained lightly (2 to 5 minutes) in hæmatoxylin; decolourize in acid alcohol if overstained; place in tap water until blue. Stain in Ziehl's carbol-fuchsin for 1 hour in the paraffin oven at 55° C.; wash in tepid, then in ice water (8 to 10° C.); decolourize in 10 p.c. sulphuric acid, cooled by standing several minutes in ice water, until sections are pale violet; wash in ice water and repeat application of acid if too much red colour returns; wash in ice water and stand in tap water until blue; remove sections one at a time, blot, wash rapidly with 95 p.c. alcohol from a dropping bottle. Flood with orange G dissolved in absolute alcohol from a drop bottle until the section is pale orange; wash with absolute alcohol; blot and flood with xylol; blot and mount in balsam. G. M. F.

Gelatine Carmine Injections.—R. A. MOORE (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 55–8). Gelatine carmine prepared by the following method proved successful in studies of vascular changes in nephritis:—(i) Let 80 gm. of gelatine imbibe 200 c.cm. water, and then heat to complete gel. (ii) Suspend 20 gm. of carmine in 100 c.cm. water and add ammonia until the carmine dissolves. (iii) Mix (i) and (ii) and add 15 gm. of potassium iodide. (iv) Place the mixture in a water bath at 25° C. and immerse the platinum electrode. Electrolytic hydrogen is passed over the electrode and a motor stirrer used to agitate the gelatine. Read the electrical potential on the potentiometer by

balancing against a standard cell, adding acetic acid till the reading of the voltage corresponds to a pH of 7.2. G. M. F.

A Combination of Delafield's Hæmatoxylin and Mallory's Connective Tissue Stain.—G. J. BRILMYER ("Combining a Nuclear and Differential Tissue Stain," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 122). This method intensifies the nuclear staining, the hæmatoxylin being converted to a reddish colour by the action of the acid in the connective tissue stain. No special method of fixation is necessary. (i) Stain in Delafield's hæmatoxylin for 5 minutes; wash. (ii) Stain in 0.2 p.c. aqueous sol. of acid fuchsin for 1 minute; wash. (iii) Stain for 2 to 3 hours in—Aniline blue (water sol.) 0.5 gm., orange G 2.0 gm., phosphomolybdic acid 1 p.c. aq. sol. 100.0 c.cm. (iv) Wash and pass rapidly through the alcohols; dehydrate in xylol and mount. G. M. F.

A Hæmatoxylin Erythrosin Gram-Weigert Stain.—S. R. HAYTHORN (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 128-9). A method is given for combining hæmatoxylin and erythrosin with the Gram-Weigert technique for demonstrating fibrin and the Gram-positive bacteria. It is applicable to both formalin and Zenker fixed material, is simple to use, and gives permanent preparations. The technique is as follows:—Sections are brought down to water in the usual way and are then stained in Mallory's alum hæmatoxylin for 5 to 10 minutes or longer if Zenker material is used. Rinse rapidly in acid alcohol; wash, allowing to stand in tap water 2 to 5 minutes; stain in Weigert's aniline methyl violet 2 to 5 minutes; blot; cover with Lugol's iodine solution 2 to 5 minutes; blot dry; decolourise in aniline oil 2 parts, xylol 1 part; flood with erythrosin (sat. sol. in absolute alcohol) for 30 seconds to 1 minute; wash off with aniline oil 1 part, xylol 2 parts; wash with xylol, blot and mount. The nuclei are blue; fibrin and Gram-positive bacteria are purplish blue. G. M. F.

A Rapid Frozen Section Method for Fresh Tissues.—W. H. CHASE (*J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 126-7). The method is applicable for ordinary and special stains. Sections are fixed on the slide by a 0.2 p.c. celloidin solution which completely permits dehydration and clearing without causing irregularities and artefacts, inevitable when sections are mounted after dehydration. (i) Cut sections of fresh or formalin-fixed tissue as thin and even as possible in the freezing microtome; (ii) float sections on the slide and dry slowly with the aid of a little heat; (iii) dip the fixed slide into a 0.2 p.c. celloidin solution and plunge into a dish of cold water; (iv) stain in hæmatoxylin 30 seconds to 1 minute; (v) wash in water; place in lithium carbonate for 30 seconds, wash in water 30 seconds to remove all lithium carbonate; (vi) stain in eosin for 1 to 2 minutes; wash in water; (vii) dehydrate in 95 p.c. absolute alcohol; (viii) dip in ether to remove the celloidin film and put back into absolute alcohol for 10 seconds; (ix) clear in equal parts of absolute alcohol and xylol, then in xylol, and mount in Canada balsam. G. M. F.

The Staining of Neuroglia.—H. INGLEBY ("A Modification of Achúcarro's Method of Staining Neuroglia," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, 12, 91-5). This method demonstrates the fine fibrils of Cajal's fibrous astrocytes. (1) Fixation—(a) Cajal's formol bromide: ammonium bromide 2.0 gm., formalin 14 c.cm., distilled water 84 c.cm. Use thin slices of fresh tissue (best within 6 hours after death) with evenly cut surfaces. Fix 2 to 4 days for astrocytes in the white matter of the hemispheres, 18 hours to 2 days for marginal glia, 7 to 10 days for spinal cord. (b) Picric acid saturated aqueous sol. 75 c.cm., acetic acid 5 c.cm., formalin 25 c.cm., ammonium bromide 2 gm. Make up fresh. Dissolve

ammonium bromide in formalin, add picric and acetic acid. Fix 2 to 24 hours. Best for marginal and protoplasmic glia. (2) Rinse, freeze and cut sections 15μ thick. Transfer to water, adding 2 to 3 drops of ammonia. (3) Wash and pass one by one to 10 p.c. tannic acid; warm 5 to 7 minutes at about 50°C .; cool and leave in the acid for from 10 minutes to 2 hours. (4) Transfer to water, add ammonia (3 to 6 drops to 10 c.cm.). Move sections when they recover their pliability; wash. (5) Transfer to silver bath (Da Fano's modification of Bielchowsky's method). Add 2 drops of 40 p.c. sodium hydroxide to 5 c.cm. of 20 p.c. silver nitrate. Shake well, add ammonia until precipitate is just redissolved, then add an extra drop. This keeps 3 to 4 days in the dark. Add 2 c.cm. of this to 30 c.cm. of water in a flat glass dish. Spread sections and move them occasionally. Change solution if yellow discolouration is excessive. Sections get yellowish brown. (6) Transfer to 20 p.c. formalin; sections get greenish brown in a few minutes. Wash twice. (7) Tone in gold chloride, 1 in 500; fix in 5 p.c. hyposulphite of soda, wash, transfer to 50 p.c. alcohol. (8) Mount, blot, dehydrate with absolute alcohol, clove oil or origanum oil; xylol, Canada balsam. If overstained, decolourise with potassium cyanide (2 p.c. aqueous sol.). Destaining, however, should be avoided, as finer details are liable to get lost. Perivascular connective tissue also stains. G. M. F.

A Microchemical Histological Method.—E. CHRISTELLER and K. KAISER ("A Microchemical Histological Method for Differentiation of Tissues by Means of Ferric Salts Formation," *J. Tech. Meth. & Bull. Inter. Assn. Med. Museums*, 1929, **12**, 115-17). Ferric salts proved of use for fixing the acid ingredients of tissues. Operation material and the tissues of guinea-pigs were employed. Method: immerse small slices of fresh tissue in solutions of the following iron salts—ferric chloride, ferrous chloride, ferric lactate, ferric sulphate or ferric ammonium sulphate, for 24 hours. Make frozen sections right away, or add formalin and leave for another 24 hours. Wash in distilled water, then treat with potassium ferrocyanide and hydrochloric acid. The ferric-ferrous salt formation takes place in all cases. Results—connective tissue takes hardly any iron and appears pale; the nuclei of all cells show a weak blue; red blood cells are pale green; plasma in the vessels light greenish; epithelia show a dark blue protoplasm; smooth and striated muscle are light blue. Counterstain with eosin, van Gieson or orange G. G. M. F.

The Histochemical Detection of Gold and Lead.—H. OKKELS ("Détection histochimique de l'or et du plomb," *Compt. rend. Soc. de Biol.*, 1930, **102**, 1089-91). Gold is demonstrated by the following methods:—(a) Christeller's method. The tissue is fixed in absolute alcohol and embedded in paraffin. The sections are treated with the following solution: a 5 p.c. aqueous solution of SnCl_2 is prepared, to which is added a small quantity of hydrochloric acid. The sections are placed in this acid mixture for 24 to 36 hours in the incubator at 56°C . Gold is reduced to the colloidal condition. Too long a stay in the reducing solution causes swelling of the metallic particles. (b) Less satisfactory is Borchardt's method, which consists in placing the sections in a 5 to 10 p.c. solution of silver nitrate in sunlight. Wash in distilled water, then remove the silver by a 5 to 10 p.c. sol. of nitric acid. (c) Gold may be precipitated by exposing the sections to bright sunlight for from 12 to 14 hours. (d) Micro-incineration. Lead is demonstrated by (a) micro-incineration, (b) Iwahashi's method of precipitation of formol-fixed material with sulphuretted hydrogen and subsequent treatment with H_2O_2 . (c) Fixation of tiny pieces in Almkvist's fluid (concentrated picric acid 100 and 25 p.c., nitric acid 1 p.c., saturated with sulphuretted hydrogen and kept in the cold for 24 hours, then filtered). The tissues are fixed for two days. Wash in running water for 24 hours, embed in

paraffin, and section. The dépôts of lead appear black on a yellow background; but this method is non-specific, as mercury and iron give the same reaction.

G. M. F.

Cytology.

A Cytological Study of Cellular Degeneration.—E. S. HORNING and K. C. RICHARDSON ("Cytological Studies on Cellular Degeneration of Differentiated and Undifferentiated Tissues *in vitro*," *Austral. J. Exp. Biol. & Med. Sc.*, 1929, **6**, 229-44, 8 pls.). The behaviour and appearance of undifferentiated cells during degeneration has been found to differ from that of differentiated cells. The former show a remarkable resistance to cytolysis when incubated for similar prolonged periods and under the same conditions as differentiated tissues. Lipoidal globules constantly make their appearance in degenerating cells. Nuclear changes, such as chromatolysis, amitosis, and contact between the nucleus and the cell membrane were not infrequently observed.

G. M. F.

An Experimental Demonstration of the Laws of Cytoplasmic Sexualization.—P. JOYET-LAVERGNE ("Une démonstration expérimentale des lois de sexualisation cytoplasmique," *Compt. rend. de l'Acad. des Sc.*, 1929, **189**, 409-12). The author believes that all cells in the organism are either masculine or feminine in character. The value of the intracellular oxidation-reduction potential (rH) is characteristic of the cytoplasmic sexualization; in any species, cells polarised in the female sense have an rH lower than that of cells polarised in the male sense. Female cells also have a greater tendency to store fats. In vitamin B deficiency the conditions are adverse for the formation of male cells, and it is this type of cell which degenerates first in this type of malnutrition.

G. M. F.

The Thyroid Gland and Tracheal Mucosa in Vitamin A Deficiency.—R. MCCARRISON ("The Effect on the Tracheal Mucous Membrane and on the Thyroid Gland of Faulty Food containing an Insufficiency of Vitamin A," *Ind. J. Med. Res.*, 1930, **17**, 1-5, 4 pls.). In rats fed on diets deficient in vitamin A a large proportion of the thyroid follicles are distended with colloid material, with consequent distortion of their shape. In the trachea, in addition to metaplasia of the epithelium, there occurs a chronic and protracted inflammatory reaction in which mononuclear cells, in greater or less numbers, pervade the subepithelial layer of the mucosa.

G. M. F.

Slowing and Experimental Arrest of Growth in Tissue Cultures.—E. FISCHER-PIETTE ("Ralentissement et arrêt expérimental de la croissance des cultures de tissus," *Compt. rend. Soc. de Biol.*, 1930, **102**, 1000-3, 1 text-fig., 1 graph). Solutions of activated glucose are said to have the power of slowing the rate of growth or of completely inhibiting the growth of embryo chick heart.

G. M. F.

The Rôle of Mitochondria in the Formation of Iron Pigment.—L. M. PAUTRIER and A. DISS ("Le rôle des mitochondries dans la formation du pigment ferrique," *Compt. rend. Soc. de Biol.*, 1930, **102**, 1059-60). The mitochondria of the histiocytes are believed to be capable of transforming dissolved hæmoglobin into hæmosiderin.

G. M. F.

Golgi Apparatus and Vacuome in the Suprarenal of the Pregnant Guinea-Pig.—P. A. MERLAND ("Appareil de Golgi et vacuome dans la surrenal de cobaye gravide," *Compt. rend. Soc. de Biol.*, 1929, **102**, 929-30). In the cells of the zona fascicularis of the suprarenal cortex of the gravid guinea-pig there are found vésicles which gradually increase in size in the cells as the distance from the zona glomerulosa increases. Da Fano's method for demonstrating the Golgi apparatus

shows a metallic precipitate within these vacuoles, continuous with the true Golgi apparatus. The author therefore believes that the vacuome is part of the Golgi apparatus. G. M. F.

The Fixation of Antibodies by Tissues Cultivated in vitro.—P. MENDELEEFF ("La fixation des anticorps par les tissus cultivés *in vitro*," *Compt. rend. Soc. de Biol.*, 1929, **102**, 949-51). Embryo guinea-pig heart is cultivated in a mixture of plasma and embryo juice to which antidiphtheritic serum is added. The antidiphtheritic serum is adsorbed, not only by the cells themselves, but by the medium in which they are growing. G. M. F.

Local Immunity against Diphtheria Studied on Embryo Tissues cultivated in vitro.—P. MENDELEEFF ("L'immunité locale contre la diphthérie étudiée sur des tissus embryonnaires cultivés *in vitro*," *Compt. rend. Soc. de Biol.*, 1929, **102**, 947-9). Tissues of embryo guinea-pig heart cultivated *in vitro* can be protected from the action of diphtheria toxin by previous treatment with either antidiphtheritic serum or mixtures of immune serum and toxin. Tissues treated *in vitro* with attenuated antigen which does not contain specific antibodies do not manifest a refractory state to diphtheria toxin. In other words, passive but not active immunisation is applicable to tissues cultivated *in vitro*. G. M. F.

The Factors determining the Appearance and Frequency of Giant Cells in Tubercular Lesions.—M. NASTA and M. BLECHMANN ("Sur les facteurs déterminant l'apparition et la fréquence des cellules géantes dans les lésions tuberculeuses," *Compt. rend. Soc. de Biol.*, 1929, **102**, 969-70). When rabbits are inoculated with active tubercle bacilli, giant cells are not found in the lesions; but when the rabbits are injected with attenuated bacilli, or are first partially immunised, giant cells appeared after fifteen days. G. M. F.

Chromosomes of Reptiles.—R. MATTHEY ("Chromosomes de reptiles," *Compt. rend. Soc. de Biol.*, 1930, **103**, 213-14). The number and characteristics of the chromosomes of 16 reptiles are described. G. M. F.

The Formation of Mitochondria from the Nucleus of the Glandular Cells of the Vas deferens of the Armadillo.—V. RADU ("Le noyau générateur de mitochondries dans les cellules glandulaires du canal déférent chez *Armadillidium vulgare* Latr.," *Compt. rend. Soc. de Biol.*, 1930, **103**, 285-8, 3 text-figs.). The nuclei of the glandular cells of the vas deferens of *Armadillidium vulgare* are often provided with nucleoli which contain mitochondria, frequently vacuoles, and very rarely secretion granules. These formations are extruded into the cytoplasm. In the nucleoli are also many nucleoli which stain in the centre with fuchsin, but at the periphery are composed of chromatin granules. The author believes that these chromatin granules give rise to mitochondria. G. M. F.

Histology, Embryology, etc.

A New Disease of Birds in Korea.—T. KONNO, Y. OCHI, and K. HASCHIMOTO ("Neue Geflügelseuche in Korea," *Deutsch. Tierärztl. Woch.*, 1929, **37**, 515-17, 1 text-fig.). The disease, which is due to a filterable virus, is almost always fatal. The virus is present in all tissues, organs, secretions and excretions, and is readily transmitted by simple contact and also by ingestion or inoculation. Dullness, diarrhoea and weakness are symptoms of the disease, but the most characteristic is respiratory distress. Post-mortem there are hæmorrhages in the mucous membrane of the intestine. The disease is probably identical with the "Newcastle disease" described by Doyle in this country. G. M. F.

A New Mutation of the House Mouse.—E. M. LORD and W. H. GATES ("Shaker, a New Mutation of the House Mouse (*Mus musculus*)," *Amer. Naturalist*, 1929, 63, 435-42). A new behaviouristic mutation of the house mouse is described. This mutation expresses itself in the form of nervous head movements, circling and deafness, and behaves in inheritance as a single gene character, recessive to the normal and not sex-linked. It differs in its expression from waltzing, and is shown to be due to a different factor or gene from that of waltzing. G. M. F.

The Effect of Histamine and of Local Injury on the Blood Vessels of the Frog.—R. T. GRANT and T. D. JONES (*Heart*, 1929, 14, 339). Local injury to minute vessels of the frog's tongue causes (a) a local and active dilatation independent of the nervous system, (b) a surrounding secondary dilatation dependent on the integrity of a local nervous mechanism and corresponding to the "flare" of the human reactions. The local reaction is caused, not by direct injury to blood vessels, but by some chemical substance released from the damaged tissues. In the human being this substance is probably histamine. However, histamine causes no dilatation of the frog's blood vessels either when applied locally or given intravenously. The effect in the frog is probably due to a base of the histidine-arginine fraction from skin extracts of the animal. G. M. F.

A New Case of Intersexuality in *Rana cantabrigensis*.—TSO-HSIN CHENG (*Biol. Bull.*, 1929, 57, 412-21, 1 text-fig.). A new case of intersexuality in an adult sexually mature wood-frog is described. Both gonads were intersexual; the bulk of either gonad was composed of spermatic tissue, the ovarian elements consisting of individual ova or oocytes. G. M. F.

Mollusca.

The Epiphragm in *Streptaxis*.—G. C. SPENCE (*Proc. Malacol. Soc.*, 1930, 19, 9, 2 text-figs.). A description is given of the epiphragm of *Gonaxis monrovia* (Rang) from Sierra Leone. The posterior angle divides into two portions having a U-shaped slot between them. In *Otala bessabisana* the epiphragm has the curious effect of a "crazy pavement," consisting of fragments of white shell with filled-in joints of ochreous sand mounted on the usual mucus film. G. M. F.

Sex in Mussels.—H. H. BLOOMER ("A Note on the Sex of *Anodonta cygnea*," *Proc. Malacol. Soc.*, 1930, 19, 10-14). Of 95 specimens of *Anodonta cygnea* examined microscopically, 20 were males, 54 females, 18 hermaphrodites and 3 with empty gonads. There were, however, very few, if any, true hermaphrodites, the majority being either hermaphrodite females with abundant ripe ova and a trace of sperm-morulae, or hermaphrodite males with abundant sperm-morulae and a trace of ripe ova. There is evidence to suggest that possibly sex reversal may occur in freshwater mussels as in oysters. G. M. F.

The Anatomy of *Plicatula*.—H. WATSON ("On the Anatomy and Affinity of *Plicatula*," *Proc. Malacol. Soc.*, 1930, 19, 25-31, 1 pl.). *Plicatula*.—a genus commoner in mesozoic times than at the present day—resembles *Spondylus* and *Pecten* in many anatomical features, but differs not only in having much simpler gills, but also in the characters of the mantle-edge, foot, lips, adductor muscle and nervous system. Inasmuch as *Plicatula* differs anatomically from *Spondylus* more than *Spondylus* does from *Pecten*, the old classification which placed *Plicatula* and *Spondylus* in one family and *Pecten* in another should be abandoned. G. M. F.

The Central Nervous System of *Spondylus*.—H. WATSON ("On the Central Nervous System of *Spondylus*, and What happens to a Headless Mollusc's Brain," *Proc. Malacol. Soc.*, 1930, 9, 31-6, 4 text-figs.). An alternative hypothesis to that of Dakin (*Proc. Roy. Soc.*, 1928, 103, 337-54) for the development of the nervous system of *Spondylus* is proposed. It is suggested that in *Spondylus* the greater part of each cerebro-pleural ganglion has moved still farther back along the cerebral loop than it has done in *Pecten*, until it has become merged into the visceral nerve-centre, leaving only a remnant in its original position at the side of the mouth.

G. M. F.

Arthropoda.

Insecta.

Digestion in the Tsetse-Fly.—V. B. WIGGLESWORTH ("Digestion in the Tsetse-Fly. A Study of Structure and Function," *Parasitol.*, 1929, 21, 288-321, 1 pl., 16 text-figs.). The anatomy, histology, and digestive enzymes of the mid-gut of the tsetse-fly have been investigated. Histologically the mid-gut of *Glossina* consists of three regions:—(i) An anterior segment of small pale-staining, irregularly columnar cells which comprise about half the total length of the mid-gut. The zone of giant-cells containing bacteroids, which is very limited in extent, lies at about the middle of this region. (ii) A middle segment of large deeply-staining cells, heaped together in the resting state, which is separated abruptly from the anterior segment. (iii) A posterior segment, arising by gradual transition from the middle segment, composed of regular columnar cells. After a meal blood is concentrated by the removal of fluid in the anterior segment, but it shows no other change in this region. The giant-cells are greatly flattened, but they do not regularly discharge the bacteroids which they contain, and there is no evidence that these organisms play any part in the digestion of the blood. During digestion the cells in the middle segment contain globules of secretion, and vacuolated buds of cytoplasm are set free and disintegrate in the lumen. In the posterior segment the epithelial cells become greatly vacuolated later in digestion, and are concerned chiefly in absorption. The salivary glands and proventriculus contain no digestive enzymes, and the same is true of the anterior and posterior segments of the mid-gut. The middle segment produces a very active tryptase which agrees in its pH activity curve and other properties with the tryptase of the cockroach. A peptidase is also present and a very weak amylase. The contents of the mid-gut are always slightly acid (about pH 6.5), and the tryptase present is well adapted to work at this reaction.

G. M. F.

On the Final Larval Instar of *Tipula paludosa*, Meig., and *Tipula lateralis*, Meig.—JOHN N. OLDHAM (*Proc. Roy. Phys. Soc.*, 1929, 21, 217-52, 32 figs.). The author gives a detailed description of the anatomy of the full-grown larva of *Tipula paludosa* and *Tipula lateralis*, special attention being given to the hind spiracles and to the chaetotaxy. The egg also is described, and the habits of the full-grown larva of *T. lateralis*. In conclusion a comparison is made of these two species and the closely-allied species *T. rivosa*.

J. J.

New Insects.—R. P. LONGINUS-NEVAS ("Insecta Nova," *Mem. della Pont. Acad. delle Scienze-I Nuovi Lincei*, 1929, ser II, 12, 15-32, 6 text-figs.). The present paper comprises series XIII and XIV of the author's contribution to this subject. Descriptions are given of 20 new species belonging to the order Neuroptera.

M. E. M.

Anatomy of the Grasshopper.—R. E. SNODGRASS ("The Thoracic Mechanism of a Grasshopper, and its Antecedents," *Smithsonian Misc. Coll.*, 1929,

82, no. 2, 1-111, 54 text-figs.). The principal elements in the motor mechanisms of arthropods are the muscles and the body wall, though the blood often plays an important secondary part as a hydraulic medium. All movements, however, come primarily from muscle contractions. A contracted muscle, when it relaxes, must be actively extended before it can operate again, and therefore muscles generally occur in antagonistic sets. But the muscles of insects are not necessarily opposed by other muscles; the counter-force may be produced by the elasticity of the part of the body walls on which a muscle is attached. For this reason it is often found, in studying the anatomy of insects, that a muscle has no antagonist. The major plates of the body wall of an insect are very definite structures that are constantly reproduced by the deposit of sclerotising substances throughout the whole series of insect forms, and some of them appear to be homologous with corresponding plates in other arthropod groups. The author studies his subject under the following headings: introduction, general discussion, the thoracic terga, pleura, and sterna, the thoracic skeleton of *Dissosteira*, the cervical sclerites, the prothorax, the pterothorax, the thoracic muscles of *Dissosteira*, the legs and their muscles, the wings and their mechanism, and the spiracles. The paper includes a list of references, a list of the abbreviations used on the figures, but no index of the subject-matter. M. E. M.

African Acrididae.—W. RAMME ("Afrikanische Acrididae. Revisionen und Beschreibungen wenig bekannter und neuer Gattungen und Arten," *Mitt. Zool. Museum in Berlin*, 1929, 15, 2, 247-492, 14 pls., 106 text-figs.). The main portion of this large work is devoted to descriptions of numerous genera and species, many of which are new. The systematic part is dealt with under four subsections, namely, *Acradinae*, *Pyrgomorphinae*, *Oedipodinae*, and the *Catantopinae*. An alphabetic list of the valid species and their synonymies is given, the number of valid species being 139, while a list of the uncertain species is also provided. M. E. M.

Oriental Neuroptera.—R. P. LONGINUS-NEVAS ("Insecta Orientalia," *Mem. della Pont. Acad. delle Scienze-I Nuovi Lincei*, 1929, ser II, 12, 35-56). The present paper contains series VI and VII of the author's contributions to this subject. Fifty-seven species are included, of which the following genera and species are new: Fam. *Chrysopidae*, *Cintameva sumatrensis* n. sp.; Fam. *Hemerobiidae*, *Hemerobius (Boriomyia) baikalensis* n. sp.; Fam. *Charliodidae*, *Protohermes flavipennis* n. sp.; *Protohermes walkeri* n. sp.; Fam. *Hydropsychidae*, *Macronema bifensetratum* n. sp.; *Macronema floridum* n. sp.; Fam. *Myrmeleonidae*, *Nelus* n. gen.; *Nelus griseipennis* n. sp.; *Nehoveus persicus* n. sp.; Fam. *Chrysopidae*, *Chrysopa ceasa* n. sp.; *Chrysopa rubida* n. sp.; *Cintameva bandrensis* n. sp.; Fam. *Hemerobiidae*, *Hemerobius amurensis*, n. sp.; *Noius* n. gen.; *Noius oceanicus*, n. sp.; Fam. *Sisyridae*, *Sisyra aquavivai*, n. sp.; Fam. *Mantispidae*, *Mantispilla radialis* n. sp.; *Necyla trilineata* n. sp. M. E. M.

Australian Agraptocorixa.—O. LUNDBLAD ("Die Australischen Arten der Gattung *Agraptocorixa*," *Arkiv för Zoologi*, 1929, 20, 3, no. 6, 1-19, 2 pls., 13 text-figs.). Descriptions are given of the following species:—*Agraptocorixa eurynome* Kirk, 1897; *A. hirtifrons* Hale, 1922; *A. parvipunctata* Hale, 1922. M. E. M.

Coleoptera of France.—F. PICARD ("Faune de France. XX. Coléoptères, (Cerambycidae)," *Office Central de Faunistique*, Paul Lechevalier et Cie, Paris, 1929, 1-166, 71 text-figs.). The scope of this work is indicated by the title, and the author deals, in all, with about 235 species. In an introduction covering some 39 pages the adult characters, larval morphology, biology, reproduction, and the

immature stages are described. A section is devoted to the metamorphosis, and a list of the Hymenopterous parasites is included. The author then gives an account of the bionomics and geographical distribution of the species, and later describes collection and preservation methods. The remainder of the work is devoted to the systematic study of the tribes, genera, and species. There is a bibliography of some 10 pages, and an index covering 7 pages. The form of the work corresponds to that of previous publications in the same series. M. E. M.

The Collembola Fauna of Southern India.—E. HANDSCHIN ("Beiträge zur Collembolenfauna von Süd-Indien," *Revue Suisse de Zoologie*, 1929, 36, no. 16, 229–62, 52 text-figs.). A total of 27 species are dealt with, 14 of which are described as new, namely, *Linnaniemia indica* sp. nov.; *Achorutes indicus* n. sp.; *Proisotoma tridentata* n. sp.; *Lepidocyrtus cryptocephalus* n. sp.; *Lepidocyrtus orientalis* n. sp.; *Lepidocyrtus indicus* n. sp.; *Salina tricolor* n. sp.; *Salina quatuor-fasciata* n. sp.; *Salina striata* n. sp.; *Aphysa carli* n. sp.; *Aphysa indica* n. sp.; *Aphysa fissisetosa* n. sp.; *Microphysa escheri* n. sp.; *Microphysa semiviolacea* n. sp. The species are from the following localities—Nilgiri Hills, Palni Hills, Anaimalai Hills, and Ceylon. M. E. M.

Anophelini of Brazil.—A. DA COSTA LIMA ("Sobre alguns anophelíneos encontrados no Brasil," *Instituto Oswaldo Cruz, Suplemento das Memórias*, 1929, no. 12, 275–92, 18 pls.). The author describes in considerable detail the specific and generic characteristics of the seven local Anophelini, which are classified under two subgeneric categories, namely, *Anopheles* (*Anopheles*) and *Anopheles* (*Arribalzagia*). The species recorded are *Anopheles* (*Anopheles*) *eiseni* Coquillett, 1902; *Anopheles* (*Anopheles*) *periyassui* Dyar & Knab, 1908; *Anopheles* (*Arribalzagia*) *mediopunctatus* (Lutz) in Theobald, 1903; *Anopheles* (*Arribalzagia*) *intermedius* Chagas, in Peryassu, 1908; *Anopheles* (*Arribalzagia*) *fluminensis* Root, 1927; *Anopheles* (*Arribalzagia*) *maculipes* Theobald-Edwards, 1903: syn. *Arribalzagia pseudomaculipes* Chagas; *Anopheles* (*Arribalzagia*) *minor* Lima, 1929. Keys are given for the identification of the adults, and the 18 plates illustrate by microphotography the wing scale pattern in the various species, typical breeding-places of *Anopheles maculipes*, certain larval and pupal anatomical structures, and the genitalia of *Stethomyia nimba* Theobald, 1903 (i.e., *Anopheles* (*Anopheles*) *nimbus* Theobald, 1903). M. E. M.

Two Rare Mantids.—A. DA COSTA LIMA ("Sobre dois Mantídeos pouco conhecidos," *Instituto Oswaldo Cruz, Suplemento das Memórias*, 1929, no. 12, 295–6, 1 pl.). Systematic and biological notes are given on the two species, *Eumusonia livida* (Serville) Giglio-Tos (Subfam. *Parathespinæ*, group *Musoniæ*), and *Acanthops erosa* Sauss. 1839 (syn. *A. contorta* Gerstacher, 1889). M. E. M.

Brazilian Species of Mansonia.—A. DA COSTA LIMA ("Sobre Algumas espécies de *Mansonia* encontradas no Brasil," *Instituto Oswaldo Cruz, Suplemento das Memórias*, 1929, no. 12, 297–300, 2 pls.). The paper consists of a short description of the habits of *Mansonia amazonensis* Theobald, *M. pseudotitillans* Theobald, and *M. titillans* Walker. The bites of these three species are said to be particularly painful, and the species are active from 6 a.m. to 7 or 8 p.m., entering houses readily during this period. Differences in the genitalia of the three species are illustrated by means of microphotographs. M. E. M.

Ants and Tree-hoppers.—E. A. ANDREWS ("The Mound-Building Ant, *Formica exsectoides* F., associated with Tree-hoppers," *Ann. Ent. Soc. of America*, 1929, 22, 369–91, 5 text-figs.). In the region studied near Baltimore, U.S.A., the

ant *Formica exsectoides* F. gets its food from living and dead insects and from honey-dew which is excreted, not only by aphids but coccids and membracids. In this region this ant forms foraging associations with *Eulecanium tulipiferum* Cook on *Liriodendron tulipifera*, and with *Vanduzeeia aquata* Say and *Thelia bimaculata* Fab. on *Robinia pseudacacia* L. *Vanduzeeia* and *Thelia* supply honey-dew to the ants, chiefly when young, the former with the opening of leaves in May on through successive brood into October, and the latter from late May into October. The membracids are not stimulated by the ants to move about, but seem remarkably unaffected by their presence. Membracids injured or dead are carried off by ants as food. Ants attend the membracids day and night, individuals taking turns as others become replete and return to the mound. When ants are not in attendance, the membracids eject the honey-dew with force, but when influenced by the ants, the honey-dew is discharged less violently. It is suggested that the primary influence of the membracids upon the ant is by means of some sort of exudation from the skin. Succursals made by these ants at the bases of small trees, when used by *Thelias*, are roofed over by the ants as tents that protect, and to some extent limit, the freedom of the young *Thelias* for a time. The construction of these tented succursals for temporary association of ant and *Thelia* young involves large expenditures of energy in the collection of materials. While ants attempt to obtain a monopoly of this honey-dew, there are several sorts of sugar flies associated with the ants and membracids. Some of these flies merely lick up honey-dew that has fallen and not been collected by the ants, but others drum very rapidly with their front legs before taking off honey-dew from the *Thelia* larvæ. The flies avoid the attendant ants, which seek to drive off the flies.

M. E. M.

Genetic Factors in *Drosophila*.—M. DEMEREC ("Genetic Factors Stimulating Mutability of the Miniature-gamma Wing Character of *Drosophila virilis*," *Proc. Nat. Acad. Sci.*, 1929, 15, no. 11, 834-8). The major part of the laboratory material of *Drosophila virilis* traces its origin to three collections of wild type flies (New York City, 1913; Terre Haute, Indiana, 1919; and New Orleans, 1926). The flies from the first two collections were used extensively by Dr. C. W. Metz in genetic experiments, and the stocks are at present thoroughly intercrossed. The stock of the New Orleans collection was propagated by inbreeding. In 1927 several stocks of genetic material collected in Japan were obtained by the author from Prof. Taku Komai. Of the three known factors which stimulate the mutability of the miniature-gamma gene, two, S-1 and S-3, were found among the stocks which descended from the New York and Terre Haute collections, and one factor, S-2, was found among the descendants of the New Orleans collection. The stocks obtained from Japan did not carry any gene affecting the mutability of the miniature-gamma. The modifiers of the mutability of miniature-gamma gene might have originated in the laboratory by mutation, or might have been present in the flies collected in Nature. In case they were present in the collected material, their frequency was fairly high, three having been found in the four collections. Data are presented in this paper on the inheritance of two additional genes which stimulate the mutability of the mutable miniature-gamma gene. One of these genes (S-2) is a simple Mendelian recessive, and the other (S-3) is a dominant factor.

M. E. M.

Rate of Mutability in *Drosophila*.—M. DEMEREC ("Changes in the Rate of Mutability of the Mutable Miniature Gene of *Drosophila virilis*," *Proc. Nat. Acad. Sci.*, 1929, 15, no. 12, 870-6). Three lines of mutable miniature are described, i.e., the alpha line, in which the miniature gene is mutable both in the

germ cells and in the somatic cells; the gamma line, in which the mutability is limited to the somatic cells only; and the beta line, in which the gene remains almost constant. Changes were observed from miniature-alpha to beta and gamma, from miniature-beta to gamma, and from miniature-gamma to alpha and beta. Miniature-alpha appears to be the most unstable and miniature-beta the most stable of the three mutable miniature allelomorphs as far as the changes from one miniature allelomorph to another are concerned.

M. E. M.

New Species of *Coptotermes*.—S. F. LIGHT and A. C. DAVIS ("Two New Species of *Coptotermes* Wasmann (Isoptera)," *Proc. Roy. Soc., Victoria*, 1929, 42 (n.s.), pt. 1, 62–70, figs. 1–15). This paper presents descriptions of two new species of *Coptotermes*, one from the Celebes and the other from the Solomon Islands. The method recently proposed by the senior author (Light, 1927), of expressing characters of proportion in the form of indices, justifies this addition to the already extensive list of *Coptotermes* species base of the soldier caste. It is believed that this method provides an exact and easily used means of differentiating such species, and gives promise of resolving in great part the chaotic state of the taxonomy of certain termite genera. The measurements and indices are those proposed by the senior author. In addition, the inclination of the fontanel and the fontanel aperture index are used as defined by the junior author. The two new species herein described are *Coptotermes froggatti* sp. nov. and *Coptotermes oshimai* sp. nov.

M. E. M.

Australian *Ortaliidæ*.—J. R. MALLOCH ("Notes on Australian Diptera, XXII," *Proc. Linn. Soc., N.S.W.*, 1929, 54, pt. 5, no. 225, 505–16, 2 text-figs.). A few notes on the family *Ortaliidæ* are here presented which the author has had lying beside him for some time, and are now published owing to the fact that he has become engaged in a study of the family *Tachinidæ* and other insects. Keys for the determination of the species dealt with are given, and the following new species are described: *Duomyia* (*Duomyia*) *irregularis* n. sp.; *Duomyia* (*Duomyia*) *punctifrons*, n. sp.; *Duomyia* (*Duomyia*) *nigricosta* n. sp.; *Euprosopia* *biarmata* n. sp.; *Lamprogaster* *viola* n. sp.

M. E. M.

New Australian Coleoptera.—A. M. LEA ("Descriptions of New Species of Australian Coleoptera," *Proc. Linn. Soc., N.S.W.*, 1929, 54, pt. 5, no. 225, 519–49, 8 text-figs.). The paper is described by its title, and includes the description of 52 new species.

M. E. M.

Australian *Mycetophilidæ*.—A. L. TONNOIR ("Australian *Mycetophilidæ*," *Proc. Linn. Soc., N.S.W.*, 1929, 54, pt. 5, no. 225, 584–614, 7 text-figs., 1 pl.). In the course of a collecting trip in Tasmania the author collected a large number of *Mycetophilidæ*, the nature of the country and its relatively moist climate being much more favourable to the development of an abundant *Mycetophilid* fauna than the Australian mainland. In attempting to classify this material, it was soon apparent that many more genera were represented in it than Skuse had recognised in his own collection. As the author had no access to Skuse's types, collaboration was effected with the late Dr. Ferguson to work out the Australian fungus-gnats. Until further opportunity occurs of consulting Skuse's types, the author here presents only a synopsis of the genera of the Australian *Mycetophilidæ*, as an introduction to the revision of the family, and also because Skuse's papers did not contain any key to the genera. A key is now provided which it is hoped will be of use to Australian students; it is mostly based on that published in 1925 by F. W. Edwards. To make the work as complete as possible, this key not only

contains the genera recognised from Australia, but also those from the rest of the world, as some of these are likely to be found in Australia sooner or later.

M. E. M.

Populations of Ant Mounds.—E. A. ANDREWS ("Populations of Ant Mounds," *Quart. Rev. Biology*, 1929, 4, no. 2, 248-57). Ants in the ant-hill have for the most part escaped all exact census, and it has been the purpose of the author to add something to the scanty knowledge of this aspect of these social animals. In a certain termite dwelling in Jamaica no less than 631,878 individuals were found associated. The methods of Forel of estimating the number of individuals in a nest are discussed, the possible fallacies indicated, and the author describes what he considers a surer method. This method uses as a basis of counting the community the fact that all the ants of a mound retire in a torpid condition within and under the mound every winter, when they are then thus concentrated in limited space. Descriptions are given of the technique employed in collecting the ants under these conditions, and the conclusions of the author are "that with an estimated average of some ten thousand ants in one mound, a colony near Baltimore may present about two million ants, and that a larger colony near Washington may comprise some eight million ants." The statements in the literature that such colonies contain hundreds of millions of ants seem to lack a definite basis of actual counts. Only by the taking of an actual census of the ants in many mounds is it considered that the question as to the average populations can eventually be settled.

M. E. M.

The Collembola of Ireland.—H. WOMERSLEY ("The Collembola of Ireland," *Proc. Roy. Irish. Acad.*, 1930, 39, sect. B., no. 11, 160-202, 1 text-fig.). The author is able in this contribution to add to our knowledge of these insects and their distribution in Ireland from material recently collected by himself and friends. Even now it is considered that a very large number of species must await discovery by earnest students. A brief classification of the order is provided, but the tables of species are applicable only to those already recorded from Great Britain. By this means it is hoped that interest in this group of insects will be stimulated. More than 700 species of springtails have been recorded for the world as a whole, of which 153 species are here listed as British. From Ireland only 50 species were previously known, to which 17 more are now added; one of these is new to science. Their distribution in the country is shown according to the forty counties and vice-counties first used in "Irish Topographical Botany," 1901, and subsequently in the majority of Irish faunistic and floristic lists. Twelve varieties are here recorded from Ireland belonging to 10 species, but of these, five species only occur in the varietal form. In tables the present names of the records of previous authors are given, and the author concludes with a short appendix on how to collect and where to look for Collembola.

M. E. M.

New Insect Parasites.—R. FOURS ("New Bethyloid and Serphoid Parasites from Borneo and the Philippine Islands," *Philippine Journ. Sci.*, 1930, 41, no. 1, 1-10, 4 text-figs.). This paper is based on material submitted for determination by the late Prof. C. F. Baker, and contains descriptions of 12 new species belonging to the families *Bethyloidea*, *Scelionidae*, and *Diapriidae*. The types of the new species are deposited in the collection of the United States National Museum. The manuscript was completed prior to the transfer of the Baker collection of the National Museum, and in order that there be no confusion of the specimens before the author, no change in the records or the location of types has been made in the text.

M. E. M.

Anopheline Breeding Conditions.—J. J. MEILDAZIS ("Preferential Breeding Conditions of Anopheles in the Philippine Islands," *Philippine Journ. Sci.*, 1930, 41, no. 1, 59-62, 6 pls.). In making collections of Anopheline mosquito larvæ in the Philippine Islands, a guide to the identification of some of the species is afforded by the characters of the breeding places from which the larvæ are collected. Some species show a decided preference for a particular type of breeding place, and will be found only under those conditions. The amount of shade seems to determine the presence of *Anopheles minimus* or *Anopheles maculatus*. *Anopheles ludlowi* and *Anopheles rossii* (both *A. vagus*, pool type, and *A. subpictus*, river type) are associated with sunlight. The presence of algæ or surface vegetation is also thought to determine the presence of certain species. In the main the paper is devoted to observations on the general breeding conditions favourable to the various Philippine Anopheles, namely, *A. minimus*, *A. philippiensis*, *A. barbirostris*, *A. hyrcanus*, *A. rossii*, *A. maculatus*, *A. vagus*, *A. ludlowi*, *A. subpictus*, *A. fuliginosus*, *A. kochi*, *A. tessellatus*, and *A. umbrosus*. It is stated that *A. barbirostris* is commonly found in association with *Chara* sp. M. E. M.

Nemathelminthes.

Nematoda.

Experimental Demonstration of a Strain of the Dog Hookworm, *Ancylostoma caninum*, especially adapted to the Cat.—J. ALLEN SCOTT (*Journ. Parasitol.*, 1929, 15, 209-15). A strain of *Ancylostoma caninum* was obtained from a cat. While an average of 45 p.c. of the larvæ obtained from cultures of this cat strain matured when fed to kittens, less than 1 p.c. matured in puppies. Conversely it was shown that with a strain of *Ancylostoma caninum* larvæ obtained from a dog, 50 p.c. matured in puppies and less than 5 p.c. in kittens. The experiments showed that there were two strains of parasites which, though morphologically identical, were physiologically different in their adaptation to different hosts. J. L.

A Study of Reinfection after Treatment with Hookworm and Ascaris in Two Villages in Panama.—W. W. CORT, LOUIS SCHAPIRO, and N. R. STOLL (*Am. Journ. Hyg.*, 1929, 10, 614-25). Two villages were selected for investigation, one partially sanitated and the other with no latrines, and egg counts taken before and after treatment. Reinfection in hookworm was demonstrated to be much less rapid about six months after treatment in the population of the sanitated houses than in those without latrines or having these only partially in use. The *Trichuris* count was not affected by the treatment, as the drugs used were not effective for this parasite. In the case of *Ascaris* there was very rapid reinfection after treatment, and this might even be higher than the pre-treatment level in the rainy season, when also there was a decided increase in the untreated groups. J. L.

The Suitability of Various Bacteria as Food for Hookworm Larvæ.—OLIVER R. MCCOY (*Am. Journ. Hyg.*, 1929, 10, 140-56). Eggs of *Ancylostoma caninum* which were obtained for the experiments, free of fæces and sterilised, hatched normally in agar cultures of various bacteria, growth of the larvæ to the infective stage being obtained in 22 of the 25 species of bacteria tested. No growth was obtained on dead bacteria or on bacteria-free filtrates of suspensions of bacteria in normal saline. Very few larvæ survived after 10 days in autoclaved faecal cultures, but large numbers reached the infective stage if such cultures were

subsequently inoculated with bacteria. The results of the experiments indicated that hookworm larvæ utilised living bacteria as their essential food. J. L.

Erratic and Wandering Nematelminthes found in the Tissues of Man in Rio de Janeiro.—C. MAGARINOS TORRES and E. LIBANIO VILLELA ("Nematelminthes parasites erratiques et égarés trouvés dans les tissus de l'homme à Rio de Janeiro, Brasil," *Mem. Inst. Oswaldo Cruz*, 1929, **22** 22, 161-7, 8 pls.). The following are described both from histological and pathological aspects, and are illustrated by microphotographs: (1) A fibrous tissue nodule found in the peritoneal cavity of a man of 20 and containing an undeveloped filarid (*Agamofilaria* sp.); (2) a nodule from the epididymis of a man of 55, containing a nematode larva, *Agamonematodum* sp.; (3) a larva of a nematode found in the uterine mucosa of a woman of 28; (4) inflammatory nodules containing parasitic bodies (possibly helminth eggs) in the liver of a man of 62. J. L.

Free-Living Nematodes occurring in Arable Soil in the North of Scotland.—DAVID ROBERTSON (*Proc. Roy. Phys. Soc.*, 1929, **21**, 253-63). The 38 species obtained were placed in 12 genera, and are listed with their measurements, together with a few biological notes in some cases. The specimens were obtained from soil samples taken in Aberdeen and Kincardine. No samples were taken from ground remaining uncultivated for more than three years, or from ground approaching hills or rivers. J. L.

Some New Parasitic Nematodes from Yucatan (Mexico), including a New Genus of Strongyle from Cattle.—J. H. SANDGROUND (*Bull. Mus. Comp. Zool. Harvard Coll.*, 1929, **69**, 515-25, 2 pls.). Two new genera and species of the Strongylidæ are described, *Bosicola tricollaris* from the small intestine of an ox, and *Cheiropteranema globocephala*, a single male specimen of which was recovered from the large intestine of the leaf-nosed bat, *Artibeus jamaicensis*. Two new species of *Cyrtæa* (Spiruridæ) and one new species of *Alæuris* (Oxyuridæ) are also described. J. L.

The Reaction and Susceptibility of Dogs of Different Ages to Cutaneous Infection with the Dog Hookworm, *Ancylostoma caninum*.—MERRITT P. SARLES (*Am. Journ. Hyg.*, 1929, **10**, 683-92). In young dogs the penetrating larvæ produced little or no local reaction, the larvæ migrating rapidly from the skin through the lungs to the intestine, only a few being found in the skin later than the first day after infection. In old dogs, however, there was immediate local reaction, followed by violent and prolonged inflammation. The larvæ were retained in large numbers in the skin, and many were destroyed, although some underwent a delayed migration to the intestine. A larger percentage of larvæ developed after oral than after cutaneous infection in young dogs, but in old dogs it was small by both methods, due to an age resistance. It was noted that there was a persistence of undeveloped larvæ in the intestine of dogs following cutaneous infection. J. L.

Further Experiments with Physiological Strains of the Dog Hookworm, *Ancylostoma caninum*.—J. ALLEN SCOTT (*Am. Journ. Hyg.*, 1930, **11**, 149-58). Preliminary observations of the results of experiments tended to show that the dog strain of *Ancylostoma caninum* did not appear to become, after passing from one to three generations in cats, more infective to cats or less so to dogs. A single experiment, however, indicated that the cat strain might have

become more infective to dogs and less so to cats after one generation in a dog. It had not been possible to produce a fertile cross by transfer of immature worms of the two strains of opposite sexes. Species insusceptibility to particular strains was less pronounced when immature adults were introduced than in the case of introduction of infective larvæ. J. L.

The Length of Life and Rate of Loss of the Dog Hookworm, *Ancylostoma caninum*.—MERRITT P. SARLES (*Am. Journ. Hyg.*, 1929, 10, 667–82, 4 text-figs.). The maximum length of life of *Ancylostoma caninum* was found to vary from 43–100 weeks in young dogs, but in adult dogs which had been previously infected with hookworm it was much less than this, and in some cases the worms would not develop at all. This could be attributed to age resistance, although the experiments suggested that a minor part of the resistance might be acquired. The experiments showed that most of the hookworms were lost in the first half year, and at a constant rate. J. L.

Ancylostomiasis and Ascariasis in Egypt.—D. L. AUGUSTINE, M. HELMY, and M. NAZMI (*Am. Journ. Hyg.*, 1930, 11, 136–48, 13 text-figs.). A survey was made of 12 rural villages chosen as being outside the influence of hospital services. Five were in the Nile delta and seven in Upper Egypt. The faecal specimens obtained were examined by the Willis method, and, where positive, were counted by the Stoll technique. It was found that hookworm infestations were, as a whole, light, but that the total percentage of ancylostomiasis was far greater in Upper than in Lower Egypt. The reverse was true for Ascariasis, it being almost absent in Lower Egypt, but present in about 70 p.c. of the inhabitants of the delta. The reason for this was obscure. J. L.

Quantitative Studies on the Dog and Cat Hookworm, *Ancylostoma braziliense*, with Special Emphasis on Age Resistance.—MERRITT P. SARLES (*Am. Journ. Hyg.*, 1929, 10, 453–75). Larvæ of *Ancylostoma braziliense* were fed in gelatin capsules to cats and dogs of different ages, and a quantitative study made of the resulting infestations. It was found that the worms matured more slowly and that the egg output increased more gradually and was smaller for an equal number of larvæ in adult cats than in kittens. Whereas an average of only 3.96 ± 1.92 p.c. of the larvæ given developed in adult cats, an average of 32.34 ± 4.05 p.c. developed in kittens. These observations tended to show a definite age resistance in the cat to infection with *Ancylostoma braziliense*. An age resistance was also demonstrated to this infection in the dog, where only 5.53 ± 3.21 p.c. of larvæ given developed in adult dogs, as against an average of 44.42 ± 4.06 p.c. in young dogs. It was noted that ova, larvæ, and adults of the parasite tended to be larger in dogs than in cats, and also that whereas the natural length of life of the parasite in an adult cat was less than two weeks, it might be 31 weeks in a young cat, or between 14 and 30 weeks in a young dog. The results of these experiments agreed essentially with those of Herrick (1928) with *Ancylostoma caninum*, the only marked difference being the smaller daily egg output of *Ancylostoma braziliense*. J. L.

Studies of the Blood Changes occurring in Young and Old Dogs during Cutaneous and Oral Infection with the Dog Hookworm, *Ancylostoma caninum*.—MERRITT P. SARLES (*Am. Journ. Hyg.*, 1929, 10, 693–704). In adult dogs, after oral and cutaneous infection, there was a marked leucocytosis.

Eosinophiles were at first decreased in number, and then gradually rose to an eosinophilia of 17-42 p.c. on the 10th-14th day after the infection. In young dogs marked leucocytosis and eosinophilia were rare. While infection with 20,000 larvæ produced only 25 worms in adult dogs, and no significant change in the number of red blood corpuscles or hæmoglobin content, in young dogs 10,000 larvæ produced an infestation of over 1,000 worms and caused an acute and fatal anæmia in two weeks after the infection. J. L.

Contribution to the Knowledge of the Structure of *D. medinensis*.—M. B. MIRZA ("Beiträge zur Kenntniss des Baues von *Dracunculus medinensis* Velsh," *Zeitschr. Parasitenkunde*, 1929, 2, 129-56, 33 text-figs.). The author has made a detailed study of the adult female worm by means of whole specimens and sections. The head is provided with six papillæ, the lateral papillæ of Fedschenko being absent. The digestive system is degenerate. Parts of the œsophagus are obliterated, and its lumen can in places no longer be made out. The anus is closed by coalescence with the cuticle. The excretory system was also degenerate, only parts of the lateral canals being apparent. Leuckart's "dorsal commissure" was probably a rudimentary constituent of the excretory system. With regard to the nervous system, Leuckart's so-called "ganglion" was the nucleus of a gigantic ganglion cell lying dorsal to the wall of the large gland, and was apparently homologous with Goldschmidt's "cell 47" of *Ascaris*. Some of the laterally running nerves from this cell united ventrally to form a ring which encircled the glands, and from which also fibres ran out parallel with the gland walls towards the tail. The dorsally running fibres were shorter than the ventral. How the two lateral and four marginal head papillæ were innervated was not clear. J. L.

Contribution to the Knowledge of the Strongyloidea Parasites of *Tapirus americanus*.—LAURO TRAVASSOS ("Contribution à la connaissance des Strongyloidea, parasites du *Tapirus americanus*," *Mem. Inst. Oswaldo Cruz*, 1929, 22, 135-9, 6 pls.). A description is given of the following two species: *Murshidia monostricha* (Diesing 1851) and *Kiluluma longipene* (Molin 1861) Trav. 1928. Their synonymy is discussed. J. L.

A Study of the Influence of the Rainy Season on the Level of Helminth Infestations in a Panama Village.—W. W. CORT, LOUIS SCHAPIRO, W. A. RILEY and N. R. STOLL (*Am. Journ. Hyg.*, 1929, 10, 626-34). Studies of egg counts made in a village in Panama at the beginning, middle, and end of the rainy season, failed to show any increase of hookworm or Trichuris infestation. There was, however, a remarkable increase in the *Ascaris* counts in the third examination as compared with the first and second, which was especially evident in the worst "ascaris families." This suggested that there was a considerable yearly fluctuation in the level of *Ascaris* infestations in a region with a long dry season. J. L.

Two New Species of Nematodes from Indian Hosts.—P. A. MAPLESTONE (*Rec. Ind. Mus.*, 1929, 31, 87-92). The two species described, *Kalicephalus bengalensis* and *Habronema indica*, were recovered respectively from the intestine of the rat-snake (*Zamensis mucosus*) and the gizzard of an Indian roller (*Coracias indicus*), both of which animals died in the Calcutta Zoological Gardens. J. L.

Platyhelminthes.

Trematoda.

Brief Notes on New Trematodes, II.—S. GOTO and Y. OZAKI (*Jap. Journ. Zool.*, 1929, 2, 369–83). Four new genera—*Atractotrema*, *Trigonotrema*, *Hexangium* and *Plehnia*—and four new species are described and illustrated.

J. L.

Studies on the Trematode Family Strigeidae (Holostomidae). No. XIX. *Diplostomulum scheuringi* sp. nov. and *D. vegrandis* (La Rue).—R. CHESTER HUGHES (*Journ. Parasitol.*, 1929, 15, 267–71). A new species of metacercaria, *Diplostomulum scheuringi*, is described, together with some observations on the morphology and behaviour of *Diplostomulum vegrandis* (La Rue).

J. L.

Studies on the Trematode Family Strigeidae (Holostomidae). No. XIV. **Two New Species of Diplostomula.**—R. CHESTER HUGHES (*Occasional Papers Mus. Zool., Univ. Mich.*, 1929, no. 202, 1 pl.). In addition to describing the two new species, one parasitic in a snail, the other from a fish, the author discusses the characteristics and nomenclature of the larval group *Diplostomulum*, and gives comparative synopsis of the other known species.

J. L.

Life-History Studies on the Trematode Family Poncephalidae.—A. E. WOODHEAD (*Trans. Amer. Micr. Soc.*, 1929, 48, 256–75, 1 pl.). The author has described and illustrated the structure and all stages in the life-history of *Bucephalus papillosus* n. sp., a gasterostomatous trematode from freshwater bass. The peculiar *miracidium*, with its cephalic plates and posterior jointed appendages, is described in detail for the first time.

J. L.

Protozoology.

Foraminifera of the "Siboga" Expedition.—J. HOFKER ("Part 2. Families Astrorhizidae, Rhizamminidae, Reophacidae, Anomalinidae, Peneroplidae, with an Introduction of the Life-Cycle of the Foraminifera," *Leiden*, 1930, 79–170, 26 pls., 22 text-figs.). Nothing on the scale of these Siboga monographs has been published for many years. The first portion deals with the life-cycle of (1) *Miliolina circularis* (Bornemann), in which the formation of mud-cysts was observed and both microspheric and megalospheric generations were studied, the latter exhibiting both small and large proloculum; and (2) *Eponides* (= *Pulvinulina*) *repandus* (F. & M.), which was also observed to form mud-cysts and to exhibit the same differentiation of the proloculum. The reproduction of the microspores takes place within a cyst. Other chapters deal with the author's theory of Trimorphism and its application to systematics, and the nomenclature of the shell-structure, and are of the greatest interest and value, even when subject to further argument. If Hofker's conclusions could be generally accepted, the systematics of the foraminifera would be an easier study than they have tended to become of late years. He concludes that a specific name should never be based upon—(1) secondary shell structure (pillars, beads, spines, etc.); (2) form and size of the embryonic apparatus of the megalospheric generation, if the student does not know all about the different megalospheric generations in the species and their relationships; (3) differences in the shape and dimensions of the chambers; and, finally, that every species should exhibit at least three different forms. The second portion of the paper deals with the systematics of a few species only, and not all of the author's conclusions will be generally

accepted. Some appear to be merely theoretical *obiter dicta*, as where he expresses his belief that such forms as *Vanhoeffenella* and *Crithionina* "may be reproductive stages of other Foraminifera, etc." Others may be based on the study of insufficient material, and that in a preserved condition only, as when he concludes that the very localised and distinctive *Rhabdammina irregularis* Carpenter represents only broken terminals of the branches of the universally distributed species *Rhabdammina abyssorum* Carpenter. Much space is devoted to that most involved genus *Carpenteria*, and Hofker's conclusions here are little short of revolutionary. *Sporadotrema* Hickson is stated to be nothing else than a typical *Carpenteria*, while *Anomalina polymorpha* Costa, one of the few universally accepted species of foraminifera, is regarded as merely a microspheric generation of *Carpenteria utricularis* Carter. However, these and other controversial points cannot detract from the value of the report and must add to its interest. The illustrations are admirable, though some of the photographs are rather dense. A. E.

Hasteriginella as a Fossil.—J. A. CUSHMAN ("Fossil Species of *Hasteriginella*," *Cont. Cushman Lab. Foram. Research*, 1930, 6, no. 89, 17–19, figs. on pl. 3). *Hasteriginella* was founded by Cushman in 1927 for the reception of the curious *Hasterigerina digitata* Rhumbler, one of the most specialised of the Globigerinidæ, and known only as a pelagic and recent species. It is characterised by elongate, club-shaped chambers, armed at the extremities with long slender spines, the early chambers being globigerine, the later ones becoming gradually elongate. In 1928 Nuttall described a species from the Eocene of Mexico, *H. eocanica*, distinguishable owing to the absence of the terminal spines. Another new species, *H. jarvisi*, is now described from the Upper Eocene of Trinidad, in which the chambers are more slender than in *H. eocanica* Nuttall, and the ends of the chamber are pointed and spinous. The Trinidad material is a typical *Globigerina*-ooze. The genus has not so far been recorded from any later Tertiary strata, but the gap may be filled when the deep-water deposits of the late Tertiary age which exist in some parts of the West Indies are studied. A. E.

The Genus Patellina.—J. A. CUSHMAN ("Some Notes on the genus *Patellina*," *Cont. Cushman Lab. Foram. Research*, 1930, 6, no. 88, 11–17, figs. on pl. 3). The type of the genus *P. corrugata* was described by Williamson in 1858, and is a characteristic and common species on European coasts and elsewhere. The genus is one of the most primitive of the Rotaliidae, and its range extends back to Permian deposits, the earliest species being more primitive than the recent forms. Many different things have from time to time been assigned to Williamson's genus. Some of these are ill-defined, and more must be learned about them before their place can be established with certainty, while other species recorded as *Patellina* are now known to belong to other genera. There is a useful *résumé* of the recorded species, with references to the literature, and some suggestions as to the real position of the uncertain forms. A. E.

Cretaceous Foraminifera from Texas.—J. A. CUSHMAN and C. I. ALEXANDER ("Some Vaginulinas and other Foraminifera from the Lower Cretaceous of Texas," *Cont. Cushman Lab. Foram. Research*, 1930, 6, no. 87, 1–10, 2 pls.). The genus *Vaginulina* is always conspicuous and common in Lower Cretaceous deposits, and the species are very variable in form and ornament. The shape of the test differs greatly in the megalospheric and microspheric forms, and wherever a large series of specimens is available, many intermediary forms will be found. As a result of this variability, many specific names have been used for different

forms of one species. Careful study of a large series shows, however, that some of the features are constant no matter how much others may vary, and on the basis of these more constant characters a number of the forms of the Texas series are considered and figured, their synonyms being given. There are no new species of *Vaginulina*, but the paper closes with descriptions and figures of seven new species belonging to other genera. A. E.

Mexican Fossil Foraminifera.—W. STORRS COLE and RUTH GILLESPIE ("Some Small Foraminifera from the Meson Formation of Mexico," *Bull. Amer. Paleont.*, 1930, 15, no. 57B, 15 pp., 4 pls.). The Meson formation is of Middle Oligocene age, and the material yielded a considerable fauna of large and small foraminifera. The larger *Lepidocyclinae*, etc., are being monographed by Dr. Wayland Vaughan, but a list is furnished for correlation purposes. About 40 species of the smaller genera are described, including 6 new species or varieties. The plates are very good. A. E.

Lower Pennsylvanian Foraminifera.—J. J. GALLOWAY and C. RYNIKER ("Foraminifera from the Atoka Formation of Oklahoma," *Oklahoma Geological Survey, Circular no. 21*, 1930, 36 pp., 5 pls.). Thirty-three species of foraminifera, six of which are described as new, were found in an outcrop of shale of Lower Pennsylvanian age. The associated fauna included algæ, sponges, crinoids, brachiopods, bryozoa, gasteropods and ostracods, and is described as dwarfed, most of the specimens being less than 5 mm. in length. There are few larger fossils. Very few of the genera are arenaceous; the fundamental wall structure of all, except *Tolypammina* and *Nodosinella*, is calcareous and transversely fibrous. There is no evidence from the Atoka fossils that the calcareous foraminifera were derived from the arenaceous forms, but much evidence conversely. Nor is there any evidence that chambered forms were derived from tubular. Both tubular and chambered forms have globular prolocula, but none of the many chambered forms have a tubular early stage, as would be expected if they had been derived from tubular forms. The paper is well illustrated. A. E.

A Cretaceous Fossil.—C. VAN RIJSINGE ("Die Foraminiferen aus dem Senon Limburgens. No. 8. *Rhabdammina cretacea* nov. spec.," *Natuurhistorisch Maandblad*, 1928, no. 7, 98–101, 1 pl.). Describes and figures a new arenaceous organism from a marlstone near Maastricht. Superficially it bears some resemblance to the well-known *Saccammina carteri* Brady from the Carboniferous Limestone, but a study of sections has convinced the author that it is a *Rhabdammina*. A. E.

Dictyoconoides a Synonym of Rotalia.—C. VAN RIJSINGE ("Some Remarks on *Dictyoconoides* Nuttall (= *Conulites* Carter = *Rotalia* Lamarck"), *Ann. Mag. Nat. Hist.*, 1930, 5, 116–35, 2 pls., 12 text-figs.). Since Carter created the genus *Conulites* in 1861 for some conical fossils from Scinde, the objects have been the subject of much controversy and transferred at different times to other genera. Nuttall, in 1925, proposed the new generic name *Dictyoconoides* on the grounds that *Conulites* was preoccupied and that Carter's specimens were something like *Dictyoconus*. L. M. Davies, in 1926, published an elaborate study of Carter's genus, and described some new species from N.W. India. Van Rijsinge has had the opportunity of studying material obtained from Major Davies, and deals at length with the history of the genus and also with its internal structure as shown in sections. He concludes that *Dictyoconoides* or *Conulites* possesses a typical Rotalid canal system and other Rotalid characters, viz., a spiral of chambers, conical shape,

finely perforate walls and a closed umbilicus. As these characters are sufficient to indicate a typical *Rotalia*, the name *Dictyoconoides* Nuttall must be replaced by *Rotalia* Lamarck. Trimorphism was observed in *Rotalia kohaticus* (Davies). The paper is fully illustrated. A. E.

Some Lituolidæ from Shallow Water.—E. LACROIX ("Les Lituolidés du plateau continental méditerranéen entre Saint-Raphaël et Monaco," *Bull. de l'Institut Oceanographique*, 1930, no. 549, 16 pp., 21 text-figs.). As with the *Astrorhizidæ*, the *Lituolidæ* of the Mediterranean coast-line show an extraordinary mixture of shallow-water forms with species hitherto known only from great depths or high latitudes. What is still more remarkable is that while some littoral species, as *Ammobaculites pseudospirale* (Williamson) and *Haplophragmoides canariensis*, (d'Orbigny) are abundant, others, as *Trochammina ochracea* (Williamson) and *T. plicata* (Terquem), are extremely rare, though they are usually plentiful in any gathering containing the first-named forms. Among the more interesting of the deep-water species recorded are *Reophax cylindricus* Brady, *Haplophragmoides scitulum* (Brady), and *H. subglobosum* (G. O. Sars), all typical deep-sea species. One new species and three new varieties are described. The text-figures, though small and rather crude, are quite sufficient for purposes of identification. A. E.

Further Astrorhizidæ from Shallow Water.—E. LACROIX ("Les Astrorhizides du littoral méditerranéen entre Saint-Raphaël et Monaco," *Bull. de l'Institut Oceanographique*, 1929, no. 545, 22 pp., 32 text-figs.). In this very interesting paper Dr. Lacroix continues his researches into the abnormal shallow water foraminiferal fauna of the Monaco coast (see abstract of previous paper in this Journal, 1929, p. 47). Nineteen additional species and varieties are described and figured, most of which have hitherto been known only from deep water or Arctic seas. Some of the forms are found in abundance, while others are extremely rare. There is also a remarkable disparity in the sizes of the specimens. *Thurammina papillata* Brady, for example, is described as very abundant at all stations, but its size varies only between 0.05–0.1 mm. as compared with 0.23–1.7 mm., the dimensions given by Brady for the type, and in our experience often exceeded. *Technitella legumen* Norman, on the other hand, a species of somewhat rare occurrence elsewhere, is reported to be quite common in the Bay of Beaulieu, where it attains even more than average dimensions. Many other interesting features are detailed in the author's notes—the significance of which may perhaps become more apparent, as he remarks, when the studies which he is pursuing are sufficiently advanced to permit a comprehensive view. A. E.

Upper Cretaceous Foraminifera from Tennessee.—W. BERRY and L. KELLEY ("The Foraminifera of the Ripley Formation on Coon Creek, Tennessee," *Proc. U.S. Nat. Mus.*, 1929, no. 2816, 1–20, pls. 1–3). The material was from the *Exogyra costata* zone at the base of the Ripley formation (Upper Cretaceous), and the foraminifera were extremely well preserved. All the genera and species, with the exception of the pelagic forms, are known to inhabit fairly shallow water, which, coupled with the abundance of glauconite, indicates that the deposit was laid down in a shallow sea, a fact confirmed by the associated mollusca. The fauna as a whole has strong Cretaceous affinities, but so many species are new that close comparisons are impossible. Thirty-seven species and varieties are described and figured, of which 19 are new to science. A. E.

Blood Picture in Cats infected with Trypanosomes.—J. ANDREWS and E. P. SANDERS ("Changes in the Blood of Cats infected with *Trypanosoma*

equiperdum," *Amer. J. Hyg.*, 1928, 8, 947-62, 5 diagrams). During the course of infection with *T. equiperdum* the blood of cats undergoes the following changes: (1) Progressive anæmia; (2) general leucopenia; and (3) terminal hypoglycæmia.

C. A. H.

Blood Picture in Experimental Feline Amœbiasis.—E. P. SANDERS ("Changes in the Blood Cells of Kittens resulting from Infections with *Endamœba histolytica*," *Amer. J. Hyg.*, 1928, 8, 963-89, 5 diagrams). Blood counts were made in kittens experimentally infected with *Endamœba histolytica*. The infection causes a slight anæmia, loss in weight, polymorphonuclear leucocytosis, coupled with a rise in large mononuclears. Terminal bacteræmias may be present in amœbic kittens. The severity of leucocytosis in kittens is independent of formation of liver abscesses and of bacterial blood stream infection.

C. A. H.

New Mammalian Coccidia.—J. ANDREWS ("New Species of Coccidia from the Skunk and Prairie Dog," *J. Parasitol.*, 1928, 14, 193-4, 1 pl.). *Eimeria mephitidis* sp. n. from the skunk, North America. The oocysts are oval to spherical, measuring $17-25\mu \times 16-22\mu$. The wall is double-layered, and there is a micropyle. Sporocysts oval, with rostrum at one end. Measurements, $10-12\mu \times 7-9\mu$. There is no oocystic residue, but only sporocystic residues. *E. cynomysis* sp. n., from the prairie dog, North America. Oocysts oval, measuring $33-37\mu \times 28-32\mu$. Wall double-layer, rough surfaced, with a micropyle. Sporocysts seed-shaped, with an inconspicuous rostrum. Dimensions, $13 \times 17\mu \times 8-12\mu$. Oocystic residue absent, sporocystic residues present.

C. A. H.

Factors Influencing Locomotion in Amœba.—D. L. HOPKINS ("The Effects of the Substratum, Divalent and Monovalent Cations on Locomotion in *Amœba proteus*," *J. Morph. & Physiol.*, 1929, 48, 371-83, 3 charts). A study of the effects of four divalent cations (Ca, Sr, Mg, Ba) and four monovalent cations (Li, Na, K, Rb) on locomotion in *Amœba proteus*. The rate of locomotion is dependent upon the nature of the substratum, the nature of the different cations present, and the ratio of the amount of the monovalent cations to that of calcium and strontium.

C. A. H.

Cultivation of Amœba.—D. L. HOPKINS and P. L. JOHNSON ("The Culture of *Amœba proteus* in a Known Salt Solution," *Biol. Bull.*, 1929, 56, 68-73, 1 text-fig.). The following culture medium, the inorganic composition of which was accurately estimated, was devised: CaCl_2 0.02219 gm., NaCl 0.23380 gm., KOH 0.0499 gm., KH_2PO_4 0.34030 gm., dialyzed hay extract 10 cc., H_2O to 1,000 cc. In this medium *Amœba proteus* grows and multiplies rapidly. By adding potassium phosphate buffer gradually the optimum H-ion concentration can be reached and kept constant without interfering with the development of the amœbæ.

C. A. H.

Evolutionary Significance of the Prociliata.—M. M. METCALF ("The Opalinidæ and Their Significance," *Proc. Amer. Acad. Sci.*, 1929, 15, 448-52, 1 text-fig.). The Opalinidæ are considered as a group of protozoa intermediate between the Mastigophora and the true Ciliata. They have both the longitudinal fission of the former and the transverse fission of the latter. The two nuclei of the Prociliata (to which the Opalinidæ belong) have not yet become differentiated into a genetic (micronucleus) and metabolic (macronucleus) nucleus as in the Euciliata. But, though alike, each of their nuclei contains two sorts of chromatin—metabolic

and genetic. As regards the opalinid hosts, their geographical distribution, studied in the light of their parasites, affords valuable data on the origin and migration of both the host groups and the parasite groups.

C. A. H.

Nucleus-plasma Relation in Stentor.—L. H. BURNSIDE ("Relation of Body Size to Nuclear Size in *Stentor coeruleus*," *J. Ex. Zool.*, 1929, **54**, 473-83). A number of individuals of the ciliate *Stentor coeruleus* were cut into two or more parts containing varying proportions of the nuclear mass. These fragments regenerated and reproduced. Measurements were made of the descendants for several generations of fifty of these regenerated individuals. No difference in size among the descendants resulted from the different quantities of nuclear material present in the ancestors. Regulatory processes occurred, individuals with small amounts of nuclear material increasing that amount, and those with large proportions of nuclear material decreasing that proportion. In later generations individuals of normal size resulted.

C. A. H.

Indefinite Reproduction in Didinium.—C. D. BEERS ("On the Possibility of Indefinite Reproduction in the Ciliate *Didinium* without Conjugation or Endomixis," *Amer. Natural.*, 1929, **63**, 125-9). A pure line of *Didinium nasutum* was cultured in Hopkins's "modified Ringer solution II," with *Paramecium* as food for 1384 generations in the absence of both conjugation and endomixis. At the end of the experiment the infusoria were as vigorous in regard to fission-rate, death-rate and encystment-rate as at the beginning of culture, and they were quite normal structurally. It is concluded that *Didinium* retains its vitality and is capable of indefinite reproduction without conjugation or endomixis under adequate cultural conditions.

C. A. H.

Excretion of Nitrogen in Ciliates.—J. H. WEATHERBY ("Excretion of Nitrogenous Substances in the Protozoa," *Physiol. Zoology*, 1929, **2**, 375-94, 4 diagrams). The ciliates *Paramecium*, *Spirostomum*, and *Didinium* were used in the experiments described. A large number of organisms were washed, placed in a modified Ringer's solution (CaCl₂ 2.22 gm., KCl 0.178 gm., NaCl 2.24 gm., water to make 30 litres), allowed to remain for a time, and then removed by filtration. The filtrate was tested for various nitrogenous substances, as follows: ammonia with Nessler's reagent, urea by hydrolysis to ammonium carbonate by means of urease and subsequent determination of ammonium as above, uric acid by the Benedict blood-filtrate test, creatin by conversion to creatinin, and the latter by Jaffe's and Weyl's test. The bulk of nitrogen excreted by *Paramecium* and *Spirostomum* is in the form of urea, and in the case of *Didinium* ammonia. Only part of the nitrogenous substances is excreted through the contractile vacuole, most of them passing by dialysis directly to the exterior through the cell-membrane.

C. A. H.

Volumetric Studies on Amœba.—H. M. CHALKLEY ("Changes in Water Content in *Amœba* in Relation to Changes in its Protoplasmic Structure," *Physiol. Zoology*, 1929, **2**, 535-74 16 diagrams). This is an investigation into the relation existing between the water content of *Amœba proteus*, as indicated by changes in volume, and the balance between the liquefying and solidifying tendencies in its cytoplasm, as shown by changes in the volumetric ratio between the more solid film-supported plasmagel and the more liquid plasmasol. The volume is calculated indirectly from measurements of outline drawings of the amœba as seen from above and from the side, and directly by measurement of the animal after it has been

caused to assume the form of a cylinder of known diameter. In both cases special apparatus, described in the text, was used. The influence of various solutions, mechanical stimulation, and reaction of medium upon the volume of *Amæba* is described. The increase and decrease in water content (volume) are due to changes in the colloidal state of the cytoplasm. C. A. H.

Excystation of Coccidial Oocysts.—J. ANDREWS ("Excystation of Coccidial Oocysts *in vivo*," *Science*, 1930, **71**, 37). A method for testing the viability of oocysts *in vivo* is described. Segmented oocysts from various mammals have been used. These are concentrated by centrifugation, and suspended in several drops of sweet milk. The material is offered to a starved rat. An hour after ingestion of the oocysts the rat is killed and the intestine removed. By examining various places in the intestine (recognisable macroscopically) microscopically, all stages of excystation, if the oocysts were normal, may be found. C. A. H.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Meiosis in Triticum and Aegilops Hybrids.—F. KAGAWA ("Cytological Studies on the Pollen-formation of the Hybrids between *Triticum* and *Aegilops*," *Jap. Journ. Bot.*, 1929, 4, 345–61). Microsporogenesis was studied in the F_1 individuals resulting from the following crosses: *Aegilops cylindrica* \times *Triticum dicoccum* and *A. ovata* \times *T. polonicum*. The haploid chromosome number in all the parent species is 14. In the hybrid plants 28 univalent chromosomes are present at heterotypic metaphase. In no case is the formation of compact gemini observed. Two chromosomes of similar size are sometimes seen connected longitudinally at metaphase and anaphase. Rarely three such connected chromosomes are seen in F_1 plants of *A. cylindrica* \times *T. dicoccum*. Such connected chromosome groups of both hybrids are probably bivalent or trivalent chromosomes of homologous units. Both F_1 hybrids also occasionally show the presence of bipartite chromosomes consisting of two non-homologous members which differ considerably from one another in size. At anaphase the halves of the split univalent chromosomes may travel to opposite or the same poles. Distribution takes place at random in both divisions, and is accompanied by chromosome lagging. These irregularities result in polycary and polyspory. In the F_1 of *A. cylindrica* \times *T. dicoccum* the formation of a restitution nucleus is observed, making possible the production of diploid pollen grains. In the F_1 of *A. ovata* \times *T. polonicum* connected or fused pollen mother-cells are sometimes observed. In one case a giant pollen mother-cell contains the tetraploid number of univalent chromosomes. All individuals of both hybrids examined are completely sterile to self-pollination. J. L.

The Bearing of Chromosome Morphology on the Phylogeny of Cereals.—F. KAGAWA ("On the Phylogeny of Some Cereals and Related Plants, as considered from the Size and Shape of Chromosomes," *Jap. Journ. Bot.*, 1929, 4, 363–83). The size and shape of chromosomes have been studied in root-tips of species of *Triticum*, *Aegilops*, and *Hordeum*. In *Triticum*, a tetraploid species, *T. durum*, and two hexaploid species, *T. Spelta* and *T. compactum*, are found to have chromosome sets which contain some chromosome types which are not present in the chromosome complement of the diploid *T. monococcum*. The length ratios between shortest and longest chromosomes also differ considerably in the diploid and polyploid species. Thus the chromosome set of *T. durum*, *T. Spelta*, and *T. compactum* does not represent reduplication of that of *T. monococcum*, though the chromosome numbers are definite multiples of that of *T. monococcum*. Similar observations lead to the conclusions that the tetraploid *Aegilops ovata* and the tetraploid *Hordeum jubatum* are not derived from reduplication of a chromosome set similar to those of the diploids *A. speltoides* or *H. distichum* respectively. It is suggested that *T. durum*, *T. Spelta*, and *T. compactum* have been phylogenetically

derived from crosses occurring between certain ancestral forms having different chromosome content. These species and the polyploids *T. polonicum*, *T. dicoccum*, and *T. vulgare* may have certain ancestral forms in common. J. L.

The Bearing of Chromosome Morphology on the Phylogeny of Triticum and Aegilops.—F. KAGAWA ("A Study on the Phylogeny of Some Species in *Triticum* and *Aegilops*, based upon the Comparison of Chromosomes," *Journ. Coll. Agric., Imp. Univ., Tokyo*, 1929, **10**, 173–228). The somatic chromosomes in four species of *Triticum* and two species of *Aegilops* have been compared on the bases of their length, and the number and relative positions of the constrictions. Root-tips of the plants were fixed after treatment with dilute chloral hydrate. The tetraploid species *T. polonicum* and *T. dicoccum* and the hexaploid *T. vulgare* seem to contain certain chromosome types in common with the diploid *T. monococcum*. But the numbers of such chromosomes existing in common in *T. monococcum* and the tetraploid and hexaploid species is probably 2 in the tetraploid and hexaploid species, and not double or triple the number of the corresponding chromosome in the diploid. Thus the chromosome sets of *T. polonicum*, *T. dicoccum*, and *T. vulgare* do not represent reduplication of that of *T. monococcum*. Neither do they represent the reduplication of the set of any other basic diploid species. These polyploid species may have been formed by crosses among ancestral forms with different chromosome contents. Similar observations show that the tetraploid *Aegilops cylindrica* was not produced by reduplication of a chromosome set similar to that of the diploid species *A. speltoides*. J. L.

Megaspore Development in Oenothera rubricalyx.—R. R. GATES and F. M. L. SHEFFIELD ("Megaspore Development in *Oenothera rubricalyx*, with a Note on Chromosome Linkage in *Oenothera angustissima*," *Proc. Roy. Soc., B.*, 1929, **105**, 499–517). Megaspore development is described in detail in *Oe. rubricalyx*. The nuclear behaviour is almost identical in the formation of megaspores and microspores. Eight of the 14 chromosomes form four ring pairs, and the other six form a ring at diakinesis. Occasional meiotic irregularities occur in megaspore development, such as non-disjunction, double non-disjunction, lagging and fragmentation of chromosomes. The four megaspores are arranged in a longitudinal row, that nearest the micropyle continuing development, while the other three disintegrate. Measurements show that during division the microspore mother-cell attains a volume more than twice that of the megaspore mother-cell. Meiotic divisions in microspore mother-cells of *Oe. angustissima* show all 14 chromosomes linked together in a ring. Adjacent chromosomes separate at anaphase. J. L.

Meiosis in Strains of Oenothera Lamarkiana.—R. E. CLELAND ("Chromosome Behaviour in the Pollen Mother-Cells of Several Strains of *Oenothera Lamarkiana*," *Zeits. f. induktive Abstammungs- und Vererbungslehre*, 1929, **51**, 126–45). Meiosis in the pollen mother-cells of several strains of *Oenothera Lamarkiana* is described. There is no evidence of parasynaptic association of homologous chromosomes. In all strains examined there is entire uniformity in the arrangement of chromosomes at "diakinesis." Twelve univalent chromosomes are attached end to end in a circle or chain, while two form a pair. The usual zig-zag arrangement occurs at heterotypic metaphase. Irregularities in the zig-zag arrangement, occurring to the extent of about 20 p.c., are described. Abnormal numerical distribution occurs in from 10–20 p.c. of the cells examined, 6–8 divisions occurring most frequently, though 9–5 have also been seen. Occasionally accessory nuclei form around lagging chromosomes. The cytological work of Boedijn on *Oe. Lamarkiana* is briefly criticised. J. L.

Chromosomes in Cyperaceae.—G. CLAUDE HICKS ("Cytological Studies in *Cyperus*, *Eleocharis*, *Dulichium* and *Eriophorum*," *Bot. Gaz.*, 1929, **88**, 132-49). The species of *Cyperus* studied show the following haploid chromosome numbers: 17, 21, 48, 54, 73 and variable. In *Eleocharis* the numbers are 5, 8, 8-9, 15, 18, 19 and 26-29. In *Dulichium arundinaceum* $n = 15$, and in *Eriophorum virginicum* $n = 29$. Meiotic irregularities similar to those found in known hybrids are present in *Eleocharis* and *Cyperus*. The cytological conditions of the genera described show remarkable correlation to their taxonomic variability and polymorphy. Hybridism is suggested as a probable explanation of the aneuploid conditions in the Cyperaceæ. J. L.

Chromosomes in Salix Hybrids.—A. HÅKANSSON ("Die Chromosomen in der Kreuzung *Salix viminalis* \times *Caprea* von Heribert Nilsson," *Hereditas*, 1929, **13**, 1-52. German with English summary). Cytological investigation has been made of the fertile species cross *Salix viminalis* ♀ \times *caprea* ♂ and other *Salix* forms. In the parents the haploid chromosome number is 19, and in the F_1 hybrids 19 bivalents are present at heterotypic division. In the homotypic division of the pollen mother-cells there may, however, be irregularities leading to the production of diploid pollen grains. Among the F_2 individuals a triploid *gigantea* type with 57 somatic chromosomes was found. In this plant meiotic irregularities were of frequent occurrence. The plant was staminate, and presumably arose from union of a haploid egg with a diploid sperm. *S. laurina* also occurred in the F_2 . This is a hypertetraploid plant with 82-84 somatic chromosomes. Meiosis in the megaspore mother-cells is extremely irregular, and frequently results in complete sterility. *S. aurita* is a diploid form ($n = 19$), and *S. amerinoides*, which comes from crosses between diploid *repens* and diploid *viminalis*, is tetraploid. J. L.

Chromosomes and Sterility in Hemerocallis fulva.—A. B. STOUT and TORASABURO SUSA ("Chromosome Irregularities in Relation to Sterility in *Hemerocallis fulva* clon *Europa*," *Ann. New York Acad. Sci.*, 1929, **31**, 1-30). Cytological investigation has been made of both the somatic and pollen mother-cells of the clon *Europa* of the single-flowered fulvous day lily. Plants of this clon are sterile by abortion of both microspores and macrospores, and have thus been derived solely by vegetative propagation from the original seedling plant. The basic diploid chromosome number is 12. In somatic divisions non-distribution of chromosomes frequently occurs, giving anaphase groups of 11 and 13, 10 and 14, or even 19 and 5. Further increase in the number of chromatin units may be brought about by fragmentation. During sporogenesis synapsis in all cells is normal. This is followed by extremely irregular meiotic stages, the irregularities being of the following types: increase in the number of chromatin units, their irregular distribution, the development of abnormal chromosome shapes, the irregular and abnormal organisation of the daughter nuclei, the omission of one of the reduction divisions, the formation of abnormal numbers of microspores with the abortion of many of them, a failure in the proper divisions of the primary or generative cells in certain pollen grains. Normal conditions of sporogenesis are also seen at all stages of development. The p.c. of viability of pollen in germination tests never exceeds 5. The results of cross pollination indicate similar abortion of the macrospores. The account is concluded by a discussion on the increase in number of chromatin units, the types of sterility involving abortion of spores, the inherent and hereditary nature and immediate causes of spore abortion. J. L.

Chromosomes in *Aucuba japonica*.—O. MEURMAN ("Associations and Types of Chromosomes in *Aucuba japonica*," *Hereditas*, 1929, 12, 179-209). In *Aucuba japonica* there are 32 somatic chromosomes. These consist of eight different types, each of which is present four times. These types differ in length, number, and position of constrictions. The plant is seen to be a tetraploid both from the constitution of the somatic chromosome complement and the frequent association of chromosomes in quadrivalent groups at heterotypic prophase. Quadrivalent rings or chains are most frequent, but groups of 6, 8, or 10 connected chromosomes are also found. The occurrence of univalents or groups of an odd number is rare. The ring formation is supposed to be due to a previous segmental interchange between originally non-homologous chromosomes. The connection between chromosomes going to the same pole persists in interkinesis and can be found in homotypic metaphase. Numerical non-disjunction occurs in about 25 p.c. of the cases examined. The occurrence of "interstitial," "lateral," and "multiple" chiasmata is described. Meiotic irregularities result in the frequent formation of irregular pollen groups and grains of abnormal size. J. L.

Polyploidy in *Prunus*.—O. MEURMAN ("*Prunus Laurocerasus* L., a Species showing High Polyploidy," *Journ. Genetics*, 1929, 21, 85-94). The somatic chromosome number of *Prunus Laurocerasus* is probably variable, and consists of numerous homologous basic complements of eight. Chromosome counts made at heterotypic and homotypic metaphases show that the plant studied is nearly 22-ploid, $2n = 170-180$. No definite haploid chromosome number exists in this species, for meiotic behaviour is irregular, and gametes with various numbers of chromosomes are found. These are probably viable independent of their actual chromosome number. The meiotic irregularities are due to the ability of homologous chromosomes of the original basic complements to conjugate with one another. Trivalents, 4-, 5-, 6- and 7-valent groups are seen in first metaphase. Univalents are also present; these split, and the halves separate on the spindle. Connections between chromosomes going to the same pole persist into the second division. Lagging chromosomes may be present, but tetrad formation is of regular occurrence. It is possible that an original autopolyploid condition is one of the essential stages in the formation of aneuploid series. J. L.

Interspecific Hybrids in *Brassica*.—T. MORINAGA ("Interspecific Hybridization in *Brassica*. I. The Cytology of F_1 hybrids of *B. Napella* and various other species with ten chromosomes," *Cytologia*, 1929, 1, 16-27). The haploid chromosome number in *Brassica Napella* is 19. F_1 hybrids between this species and *B. pekinensis*, *B. Rapa*, *B. chinensis* and *B. japonica* (all with the haploid number 10) have been studied cytologically. The somatic cells of the hybrids show 29 chromosomes. In heterotypic metaphase there are 19 chromosomes, ten being bivalents. There is no positive evidence of allo- or autosyndesis. The univalents are scattered on the spindle, while the bivalents are arranged at the equator. The halves of the bivalents separate normally at anaphase. The univalents which lie near the poles join the bivalents at that pole, while those lying nearer the equator divide, the daughter halves usually travelling to the same pole. Lagging chromosomes may be excluded from the daughter nuclei. Fourteen and fifteen chromosomes are most usually observed in the homotypic metaphases. Some lagging chromosomes are occasionally excluded from the tetrad nuclei, though the formation of dwarf nuclei is very rare. J. L.

Interspecific Hybrids in *Brassica*.—T. MORINAGA ("Interspecific Hybridization in *Brassica*. II. The Cytology of F_1 hybrids of *B. cernua* and various

other species with ten chromosomes," *Jap. Journ. Bot.*, 1929, 4, 277-89). The haploid chromosome number for *Brassica cernua* is 18. Cytological investigation has been made of the F_1 hybrids between *B. cernua* and *B. chinensis*, *B. japonica* and *B. Rapa*, in all of which $n = 10$. There are 28 chromosomes in the somatic cells of the hybrids. At heterotypic prophase there are 18 chromosomes, 10 of which are bivalents situated at the equator, while the univalents are scattered on the spindle. The behaviour of the chromosomes is identical to that observed in the hybrids of *B. Napella* and species with ten chromosomes. J. L.

Interspecific Hybrids in Brassica.—T. MORINAGA ("Interspecific Hybridization in *Brassica*. III. The Cytology of F_1 hybrids of *B. cernua* and *B. Napella*," *Journ. Dept. Agric., Kyushu Imp. Univ.*, 1929, 2, 199-206). The haploid chromosome numbers for *B. cernua* and *B. Napella* are 18 and 19 respectively. At the heterotypic metaphase the F_1 hybrids show 27 chromosomes, 10 bivalents and 17 univalents. The meiotic behaviour of bivalent and univalent chromosomes is similar to that reported on for the *Brassica* hybrids in Paper I. J. L.

Brassica-Raphanus Hybrids.—E. FUKUSHIMA ("Preliminary Report on *Brassica-Raphanus* Hybrids," *Proc. Imp. Acad.*, 1929, 5, 48-50). The following hybrids of *Raphanus* and *Brassica* have been obtained: *R. sativus* \times *B. oleracea*, *B. cernua* \times *R. sativus*, *B. juncea* \times *R. sativus*. All are completely sterile. In the F_1 hybrid of *R. sativus* ($n = 9$) \times *B. oleracea* ($n = 9$) $2n = 18$. No bivalents are formed at meiotic prophase. Several microspores are formed in a single mother-cell. These degenerate, and the homotypic division is entirely omitted. In the F_1 hybrid of *B. cernua* ($n = 18$) \times *R. sativus* ($n = 9$) 27 chromosomes are observed. No conjugation of chromosomes is apparent. The complicated behaviour of the univalents is described. Pollen is formed, but degenerates before maturity. *B. juncea* ($n = 18$) \times *R. sativus* ($n = 9$) give a hybrid with 27 chromosomes which show no synaptic union. The meiotic behaviour of the chromosomes is irregular, but no univalents were observed to undergo two divisions. The pollen tetrads do not come to maturity. J. L.

Meiosis in Cucumis.—L. F. HEIMLICH ("Microsporogenesis in *Cucumis sativus*," *La Cellule*, 1928, 39, 7-24). The haploid chromosome number in *Cucumis sativus* is seven. The nuclear behaviour during microsporogenesis is described in detail. Parasynaptic pairing of very slender chromatin threads occurs at early prophase. At this time also a perinuclear zone of numerous mitochondria is apparent. Mitochondria and extranuclear nucleoli are at their greatest development at the tetranucleate stage. Nucleoli always disappear prior to heterotypic anaphase. The multipolar spindle is probably of intranuclear origin. No evidence was obtained of the perinuclear zone contributing to the spindle fibres. Quadripartition of the pollen mother-cell is by cytoplasmic furrowing. The results are given of other chromosome counts recorded in the Cucurbitaceae. J. L.

Cytological Studies of North American Roses.—E. W. ERLANSON ("Cytological Conditions and Evidences for Hybridity in North American Wild Roses," *Bot. Gaz.*, 1929, 87, 443-506). Cytological investigation has been made of 107 North American wild roses. Most of these fall into three classes, diploids, tetraploids, and hexaploids, having seven as the basic chromosome number. Two triploid specimens, one octoploid and three aneuploid, were also found. The diploid plants exhibit meiotic irregularities such as incomplete pairing, lagging chromosomes, and polypspory. These irregularities are considered to indicate the hybrid nature of these

forms. The aneuploid plants with 15 or 16 chromosomes occurred in diploid cultures, and are fertile. An explanation is suggested to account for their appearance. Meiosis of both the "Drosera" and "Rosa" types is exhibited by the triploids examined. The tetraploid species all show meiotic irregularities and polypspory. They are considered to have originated by duplication of diploid hybrids and to have hybridised with each other. The hexaploids show few meiotic irregularities. They have probably not originated in N. America, but migrated as hexaploids from Asia. A specimen of *R. acicularis* was found to be octoploid and to have pure pollen. The other plants show varying percentages from under 10 to 90 of sterile pollen. The time of flowering in the species of American Cinnamomeae seems to coincide with phylogenetic relationship, those coming into flower first being the most primitive. The flowering order is: octoploids, hexaploids, diploids, tetraploids. Evidence supports the theory of the hybrid origin of orthoploid series in *Rosa*. J. L.

Chromosomes in Iris.—NATSU KAZAO ("Cytological Studies on *Iris*," *Sci. Reports, Tôhoku Imp. Univ., Biol.*, 1929, 4, 543-9). The following chromosome numbers are given for the species of *Iris* investigated: *I. Kämpferi* var. *hortensis* and *spontanica* $n = 12$, $2n = 24$; *I. sibirica* var. *orientalis* $n = 14$, $2n = 28$; *I. laevigata* $n = 16$, $2n = 32$; *I. florentina* $2n = 48$; *I. gracilipes* $n = 18$, $2n = 36$; *I. japonica* $2n = 54$. The pollen mother-cells of *I. florentina* and *I. japonica* alone show irregular heterotypic nuclear plates. In these species trivalent chromosomes are formed, the three members showing different modes of attachment. Occasionally bivalents and univalents are produced in these trivalent plants. At anaphase the chromosomes are distributed unequally, resulting in the later formation of unequal-sized pollen grains. *I. florentina* is a cultivated species, and *I. japonica* a distinct wild species of Japan. These trivalent species reproduce only by vegetative means. J. L.

Meiosis in Iris Kämpferi.—S. INARIYAMA ("Karyological Studies of *Iris Kämpferi*," *Jap. Journ. Bot.*, 1929, 4, 405-26). Some garden varieties and the wild form of *Iris Kämpferi* have been cytologically investigated. In all of them the haploid and diploid chromosome numbers are 12 and 24 respectively. Normal meiosis is described in detail. The mode of chromosome pairing is parasyntaptic. In many varieties bivalent and univalent chromosomes are scattered on the spindle, and distribution may take place at random during anaphase. Meiotic behaviour is more normal in the wild form than in the garden varieties, and the irregularities observed in the latter may be due to their hybrid nature. In *Iris* a cell plate is not formed at the end of the heterotypic division. The homotypic division produces normal tetrads, though certain pollen grains may contain variable numbers of chromosomes. It is probable that such pollen grains produced from abnormal divisions are sterile, as no variety has been found with chromosome numbers differing from 12 and 24. Other abnormalities occurring in some garden varieties are: binucleate pollen mother-cells which produce 8 nuclei with 12 chromosomes, the production of diads with diploid nuclei, and the extrusion of nuclear substance into adjoining cells. J. L.

Chromosome Structure.—LESTER W. SHARP ("Structure of Large Somatic Chromosomes," *Bot. Gaz.*, 1929, 88, 349-82). Chromosomes have been studied in the root-tips of species of *Trillium*, *Allium*, *Podophyllum*, *Vicia* and *Tradescantia*. The chromosomes consist of two chief morphological constituents which show varying affinity for stains at different periods in the mitotic cycle. The more chromatic constituent persists throughout this cycle in the form of two

chromonemata. The other forms a matrix in which the chromonemata are embedded for most of the cycle. The relation of this substance to the karyolymph is obscure. The respective matrices of two sister chromosomes separating in the anaphase are defined by a division at the end of the immediately preceding prophase; whereas their respective chromonematic constituents are defined by a division in the second preceding prophase—i.e., a chromonema divides one complete mitotic cycle in advance of the matrix. J. L.

Heterotypic Prophases.—M. C. MELBURN ("Heterotypic Prophases in the Absence of Chromosome Pairing," *Canadian Journ. Research*, 1929, 1, 512–27). The prophases of the heterotypic division in a wheat-rye hybrid, in which the chromosomes almost always fail to mate, are described and compared with those in the pure parents in which mating is normal. Up to the end of synizesis the events in the hybrid are in the main exactly the same as in the pure parents. Consequently the appearances presented in these stages can have no significance in relation to mating, because mating does not occur in the hybrid. The first striking differences in behaviour occur in the stages between synizesis and second contraction, when the spireme of the pure species forms loops, the sides of which approximate and twist about each other; in the hybrid spireme the loops are quite irregular. At diakinesis in the pure species three bivalents can be found connected, the mode of attachment being one which could result only from a telosynaptic arrangement of chromosomes. The study of the wheat-rye hybrid and its parents affords evidence favouring the theory that the spireme is composed of univalent chromosomes in tandem, and that mating by the formation of loops begins in the post synizetic period when chromosomes are relatively long and thin. This affords ample opportunity for cross-over phenomena. J. L.

Exchange of Chromatids of Homologous Chromosomes.—J. CLAUSEN ("Exchange Between Chromatids of Homologous Chromosomes," *Report of the 18th Scandinavian Nat. Congress, Copenhagen*, 1929, 26–31). A brief account is given of recent investigations of several organisms regarding the structure of chromosomes in early phases, and the evidence obtained for cytological crossing over between homologous chromosomes. Chiasmata of crossed-over chromatids are observed in some gemini of *Crepis*. In rare cases more than one chiasma is observed in a chromosome pair. These chiasmata are regarded only as evidence of an exchange between chromatids which took place at some previous early stage. The shapes of gemini are related to the number and position of chiasmata present. J. L.

The Chondriome in Phaseolus.—N. WAGNER ("Evolution du Chondriome dans les graines de *Phaseolus multiflorus*," *Comptes-rendus*, 1929, 189, 1098–1100). The form of the chondriome has been studied in the roots of embryos of *Phaseolus multiflorus*. The chondriome of the cells of the embryo in mature, but not dry, seeds is in the form of mitochondria and chondriokonts. The relative numbers of these elements differ in the different tissues, and intermediate types of chondriome element are present. As the seeds develop further, the chondriosomes become active in starch production. The chondriokonts which produce starch fragment into small plastids, while others fragment to form mitochondria. Thus, during dehydration of the seeds, the chondriome consists solely of mitochondria. Dense aggregations of mitochondria persist in the cells of the dried seeds. Prior to germination the seeds swell by intake of water, and the mitochondria are distributed throughout the protoplasm. Some are transformed into chondriokonts,

and after two days' germination the normal proportion of mitochondria and chondriokonts is restored. The form taken by the chondriome in the embryo is thus seen to be correlated with the water content of the seed. J. L.

The Vacuome of *Drosera*.—MARCEL HOMÈS ("Développement des feuilles et des tentacules chez '*Drosera intermedia* Hayne.'—Comportement du Vacuome," *Bull. Classe Sci. Acad. Roy. Belg.*, 1928, 14, 70-88). A detailed description is given of the development of the petioles, leaves, and tentacles of *Drosera intermedia*. In the successive stages of development of the tentacle the vacuome of the outer apical cells assumes the following forms: small spherical elements, rods, filaments, a uniform network which becomes polarised, and finally separate droplets formed by fragmentation. In the outer cells of the lateral part of the tentacle the vacuome develops rather earlier. In the second and third cell layers of the tentacle head the vacuome finally assumes the form of a single vacuole with diluted contents in which osmiophilic granules are precipitated by fixation. The results show that the development of the vacuome is characteristic in the different tissues. J. L.

The Vacuome of *Drosera*.—MARCEL HOMÈS ("Evolution du Vacuome au cours de la différenciation des tissus chez '*Drosera intermedia* Hayne,' " *Bull. Classe Sci. Acad. Roy. Belg.*, 1927, 13, 731-46). The primordial elements of the vacuome are distinct from those of the plastidome both as regards their reaction to osmic acid and their ability to become hydrated. The development of the vacuome shows two essential phases: first, growth by increase in quantity of the vacuolar substance, and secondly, growth by hydration of the vacuolar contents. All tissues in the meristematic condition show the vacuome composed of meta-chromes, i.e., little spherical droplets of osmiophilic substance, and in the final stage of development the vacuome is a single vacuole with contents more or less diluted by hydration. The development of the vacuome is slowest in those regions where most specialisation of tissue occurs. The details of development of the vacuome as characteristic for each tissue are described. J. L.

Anatomy.

Cork Formation in *Rhododendron*.—C. M. BARON ("Cork Formation in *Rhododendron*," *Trans. Roy. Bot. Soc., Edin.*, 1929, 30, 127-30, 3 figs.). The formation of cork in the stem of most species of *Rhododendron* is of two kinds, firstly of pericyclic and later of cortical origin. The pericyclic cork is formed early in the green stem, usually appearing first behind the gaps between the masses of pericyclic fibres. It quickly forms a cylinder, two to three cells wide, of suberised cells completely enclosing the stele. Some time after the pericyclic cork layer is complete, the cells between the pericyclic fibres on one side of the stem, and then those immediately outside them, become lightly suberised. These cells proceed to divide tangentially, and the sclerenchyma masses thus become enclosed on all sides by a layer of cork, two to three cells deep. Passing down the stem, this meristematic activity affects the cortex farther and farther out, until eventually two arcs of cork tissue are formed. These take a curved, oblique course through the cortex from the inner cork cylinder to the epidermis, cutting off between them a mass of cortex which quickly dies. New phellogen layers arise in the same way in the still living cortex, and fresh masses of cortex are thus cut off until the two phellogen layers meet and coalesce on the opposite side of the stem from which they arose. B. J. R.

Seedling Anatomy of Mesembryanthemum.—C. I. KEEN ("Seedling Anatomy in the genus *Mesembryanthemum*," *Trans. Roy. Bot. Soc., Edin.*, 1929, 30, 164–74, 4 figs.). The seedlings of the 18 species studied are all succulent, and vary only slightly in external form. The epidermis of the cotyledons is of the primitive dicotylous type, with no crystal layer and no subsidiary guard cells. The stele is diarch, of the "Diarch Cruciform Type" of Thomas, with transition of the "High Type" of Compton and "Type 3" of Van Tieghem. In every case the cotyledons have a single leaf trace. B. J. R.

Histological Studies in the Meliaceae.—P. LEDOUX ("Contributions à la Drymologie du Congo. I. Sur l'*Entandrophragma Delevoyi* De Wild. et l'appareil végétatif jeune d'une Meliaceæ du Katanga. II. Nouvelles recherches histologiques sur des *Entandrophragma* C. DC. du Congo belge," *Bull. Soc. Cent. For. Belgique*, 1928, 31, 202–4, 2 figs., and 1929, 32, 18–22). In the first paper the wood structure of *Entandrophragma Delevoyi* is described. Three seedlings of an undetermined species of *Entandrophragma* exhibit a change in phyllotaxy from opposite to alternate. In the second paper the leaf anatomy of *Entandrophragma Casimirianum*, *E. Leplæi*, and *E. roburoides* is described. Comparative histological studies in the Meliaceæ reveal characters which, without constituting specific distinctions, increase our knowledge of polymorphism in the family. B. J. R.

Anatomical Structure of Tropical Woods.—VARIOUS AUTHORS (*Trop. Woods*, 1929, 20, 4, 10, 14, 23, 26). Descriptions are given of the general properties and wood structure of *Endiandra Palmerstonii* (*Cryptocarya Palmerstonii*), *Guarea cedrata*, *Caryodendron angustifolium* and *Panda oleosa*. As regards the last-named species, the anatomy of the wood indicates relationship to certain of the Icacinaceæ and Olacaceæ, particularly the latter. There is nothing in the wood to indicate close relationship to the Burseraceæ, the family to which Engler referred *Panda* under the name of *Porphyranthus*. B. J. R.

Identification of Ceylon Species of Palaquium.—H. C. KING and A. H. G. ALSTON ("The Botanical Identity of Tawenna and Allied Timbers," *Ann. Roy. Bot. Gdns., Peradeniya*, 1930, 11, 287–97, 3 pls.). Tawenna timber, the product of *Palaquium rubiginosum*, is easily confused with other species of *Palaquium* and with the closely-allied *Isonandra lanceolata*. The paper summarises the characters by means of which the trees and their woods can be identified in the field and in the laboratory. B. J. R.

Fossil Coniferous Woods from the Tertiary of Japan.—M. TAKAMATSU ("Fossile Koniferenhölzer aus Sendai-Tertiär, I," *Sci. Rep., Tôhoku Imp. Univ.*, 1929, 4, 533–42, 3 pls., 4 figs.). Three species of fossil woods from tertiary brown coal deposits in the neighbourhood of Sendai are described. The first is identical with *Taxodioxydon sequoianum* Goth., and agrees very closely with *Sequoioxydon miyagiense* Yasui, and less closely with *Sequoioxydon hondoense* Yasui. *Taxodioxydon ishikuraense* sp. nov. shows affinities with *Cupressinoxydon wellingtonioides* Kräusel. The third species described is named *Cupressinoxydon thujopsoides* sp. nov. B. J. R.

Origin of the Vessel.—F. H. FROST ("Specialization in Secondary Xylem of Dicotyledons. I. Origin of Vessel," *Bot. Gaz.*, 1930, 89, 67–94, 20 figs.). The first of a proposed series of papers tracing the major lines of specialization in the secondary xylem. The origin of the vessel and the vessel segment is discussed. Vessel segments which retain the primitive characteristics of tracheids possess

scalariform perforations and scalariform lateral pitting. A high correlation exists between scalariform lateral pitting of vessel segments and the presence of bordered pits in the fibrous elements. There is some evidence that a sequence from the protoxylem to the secondary xylem reflects the origin of the vessel; many primitive woods show, in this sequence, all transitions from scalariform tracheids to scalariform vessel segments.

B. J. R.

Morphology.

Vegetative Propagation of Gymnosperms.—R. J. D. GRAHAM and L. B. STEWART ("Vegetative Propagation. Leaf Cuttings in Gymnosperms," *Trans. Roy. Bot. Soc., Edin.*, 1929, 30, 67-9, 1 pl.). Propagation by leaf cuttings was successful in the cases of *Ginkgo biloba* and *Podocarpus macrophylla*. Callus develops on the injured end of the petiole of *Ginkgo*. Anatomical examination of the leaf base reveals the normal sequence of events. All the living cells take part in callus formation, but the cells surrounding the paired vascular trace initiate the development. The first root initial originates in the area of small parenchyma cells lying in the bay formed by the two bundles on the adaxial side of the petiole. The passage of the root through the incumbent tissues is marked by elongation of the surrounding cells. Further roots are initiated in the callus covering the leaf base, and obtain vascular connection through the short tracheids in the central portion of the callus. The subsequent growth of the roots is unusually strong for a leaf cutting. The short initial is first seen as a swelling at the union of the first root and the leaf base, and makes its appearance on the adaxial side. *Podocarpus* leaves gave slower results, and developed roots only after an interval of several months. The injured leaf base is covered by a heavy callus. The centre of the callus consists of exceedingly numerous short tracheids with simple slit-like pits. Roots ultimately develop on the adaxial side of the callus. These roots unite with the single vascular bundle of the leaf either through the complex tracheidal mass or laterally at the corner of the crescentic leaf trace. At the time of writing shoot initials have not appeared, but this is only a matter of time now that the leaves have an established root system.

B. J. R.

Vegetative Propagation.—C. M. BARON, R. J. D. GRAHAM, and L. B. STEWART ("Vegetative Propagation. *Kalanchoe verticillata*," *Trans. Roy. Bot. Soc., Edin.*, 1929, 30, 70-1, 1 fig.). The leaves of some plants of *Kalanchoe verticillata* in cultivation at the Royal Botanic Garden, Edinburgh, exhibit certain features of interest. The leaf ends in a small linear tooth, while on the leaf margin towards the apex occur in pairs a varying number of lateral teeth, each with a linear point and a reflexed claw. The claw is an outgrowth from the base of the lateral linear tooth showing first as a small projection on the free (exterior) side of the tooth. Subsequent growth renders the claw the more prominent feature as a projection from the tooth towards the dorsal side of the leaf. At an early stage in the development of the claw the apex appears to terminate in a small green incurved tip. At a later stage this is clearly recognisable as a bud consisting of a white disc-like base bearing two leaves. Roots develop from the disc at the base of the buds on detached leaves. In old leaves the buds fall off, while in younger leaves, on drying, the buds become detached, leaving a circular scar.

B. J. R.

Staminate Flower of Echinocystis and the Systematic Position of the Cucurbitaceæ.—W. L. MILLER ("The Staminate Flower of *Echinocystis lobata*," *Bot. Gaz.*, 1929, 88, 262-84, 4 pls.). The order of appearance of the floral organs is sepal, petal, stamen. Carpels are not represented. Growth takes place

by means of both cell division and cell enlargement. The sepals are completely separate; each sepal is traversed by a single bundle which enters from the receptacle. The petals form a loose corolla tube, but their individuality is established by the presence of a separate epidermis. Each petal is traversed by five bundles, all of which enter from the receptacle. The origin of the tetrasporangiate stamen in two separate primordia is believed to establish the completeness of the bisporangiate stamen. There are indications that the three stamens are members of two stamen cycles; two are opposite petals, and one is opposite a sepal. Each division of the androecium is traversed by a single bundle connected directly with the vascular anastomosis in the base of the receptacle, rather than with the bundles which supply the perianth. It is concluded that, with polypetaly known in the family, there is no reason left for retaining the Cucurbitaceæ in the Sympetalæ. It is regarded as a highly variable border-line group between the tetracyclic and the pentacyclic positions.

B. J. R.

Morphological Notes on Conifers.—W. T. SAXTON ("Notes on Conifers. III. Further Points in the Morphology of *Larix europæa* D.C. IV. Some Points in the Leaf Anatomy of *Fokienia Hodginsii* Henry and Thomas and *Libocedrus macrolepis* B. and H.," *Ann. Bot.*, 1930, **44**, 161-71, 7+5 figs.). The observations recorded in the first paper deal with the development of the ovule. Out of a large number of ovules examined, no case has been found where the arrangement of cells closely resembles Strasburger's figures. In cones collected before the differentiation of the spore mother-cell no trace could be found of any cell which could be interpreted as a hypodermal archesporium. The conclusion seems inevitable that the spore mother-cell is directly picked out from an undifferentiated nucellus early in the autumn, and not derived from a recognisable hypodermal archesporium. This is the line of development followed in practically all other conifers. The possible exception of *Taxus* still requires confirmation. In the larch, at a slightly later stage, a unilateral stigmatic flap makes its appearance. The relations of the ovule and integument to the ovuliferous scale are shown. Strasburger's statement that after the division of the spore mother-cell the upper cell divides again, the lower cell becoming the functional megaspore, is not correct. Either three or four megaspores are formed in an axial row, but it is the upper of the two cells formed by the division which may fail to divide again. The stages here recorded for *Larix europæa* have been described elsewhere for *L. sibirica*. The material for the second paper consisted of dorsiventral shoots of *Libocedrus macrolepis* and of the juvenile form of *Fokienia Hodginsii*. The general morphology of the jointed branches is exactly of the type previously described: in both species the four leaves of one "joint" all have a different structure. The radially flattened leaf on one side is the mirror image of that on the other, but the upper leaf of the facial pair has palisade, with little or no spongy tissue and no stomata, while that on the lower side has stomata and spongy parenchyma and no palisade. One anatomical difference between the shoots of the two species examined is that the vein of the lateral leaf lies very close to the branchlet in *Libocedrus*, but runs almost medianly through the young leaf of *Fokienia*. The description of the under surface of the foliage given by FitzPatrick, as having "stomatic depressions, white patches sunk in hollows in the leaves," is not borne out by the author's examination. The transversely elongated cells of the "accessory transfusion tissue" are extremely well developed in both species. There is a continuous band of hypoderm both above and below, except opposite the stomata, and the latter are very closely crowded; a single resin canal is found on the phloem side of each leaf trace; the vascular cylinder of the stem is closely

surrounded by bast fibres, which die out when the strands pass into the leaves. Transfusion tracheids make their appearance as soon as the leaf trace is quite free from the central cylinder. A few of the cells of the accessory transfusion tissue become thick-walled, the stratification of the wall being very clearly shown. The closely-crowded arrangement of the stomata in *Fokienia* is very striking, the number per square millimetre being between 300 and 500. B. J. R.

The Structure of Poricidal Anthers.—J. R. MATTHEWS and C. M. MACLACHLAN ("The Structure of Certain Poricidal Anthers," *Trans. Roy. Bot. Soc., Edin.*, 1929, 30, 104–22, 26 figs.). The structure and dehiscence of the anther in four species selected from different families are described. In *Tibouchina semidecandra* (Melastomaceæ) the anther opens by a terminal pore through the dissolution of a previously prepared tissue. There is no mechanical layer present, and dehiscence conforms to the true porose type. The structure in *Tetratheca pilosa* (Tremandraceæ) recalls that of some of the Vacciniaceæ. A sterile column surmounts the fertile portion of the anther, indicating sterilisation of originally fertile tissue. At the apex of this column is a narrow slit which eventually opens to form a circular pore for the liberation of the pollen. Connection with the pollen sacs is established by the formation of a channel which passes through the sterile prolongation, which thus becomes a pollen-conveying tube. In *Cassia australis* (Leguminosæ) and in *Ochna serrulata* (Ochnaceæ) dehiscence is referable to the false porose type. In the former no fibrous layer develops, although the hypodermis in the apex of the anther functions as such. The restriction of the slit to a subapical position is largely due to a hypodermal clamp which prevents separation of the valves in the lower part of the anther. In *Ochna serrulata* a typical fibrous layer appears in the upper part of the anther where dehiscence is effected, but lower down it is more or less obsolete, and failure to function is partly due also to a change in structure in the epidermal cells along the line of the original longitudinal suture. The paper concludes with a short discussion in which it is suggested that porose dehiscence has been derived from longitudinal dehiscence through a shortening of the longitudinal slit. The view is held that this shortening and the final establishment of terminal or subapical pores have been reached in different ways. B. J. R.

Pteridophyta.

Stigmaria.—SUZANNE LECLERCQ ("A Monograph of *Stigmaria bacupensis* Scott et Lang," *Ann. Bot.*, 1930, 44, 31–54, 7 pls.). A morphological and histological description of specimens of *Stigmaria bacupensis*, with a historical survey. The most striking features of the species are: the massive primary wood of the main axis, consisting of spiral and barred elements developed without apparent direction; the glandular zone of principal outer cortex; and the well-defined structure of the free rootlet. The first of these features sufficiently distinguishes this species from all other forms of *Stigmaria*. It does not belong to any of the three types of structure—(1) with centripetal solid primary wood consisting of scalariform tracheids, and no pith; (2) with a well-defined ring of centripetal wood lining the pith; (3) with centrifugal primary wood: the centre of the axis seems to be hollow. *S. bacupensis* would be placed between (2) and (3). The details of structure are carefully described and freely figured, and the relationships with other species are discussed. A. G.

Psygmyphyllum and Idelopteris.—M. ZALESSKY ("Observations sur de nouveaux spécimens du *Psygmyphyllum expansum* Brongniart et sur une nouvelle plante fossile *Idelopteris elegans* n.g. et sp.," *Bull. Acad. Sci. U.R.S.S., Leningrad*,

1929, sér. vii, 717-27, 1 pl., 3 figs.). A description of *Idelopteris*, a new genus of fossil fern or pteridosperm found near Perm, and of portions of a more perfect frond of *Psygmo-phyllum expansum*. The author decides that *Psygmo-phyllum* should be narrowed down to Saprota's conception of the genus, and that *P. expansum* and *P. cuneifolium* should be considered the principal types of the genus. These two species have a forked rachis and pinnatifid pinnules with pinnatisect lobes. The frond structure recalls that of *Odontopteris* and *Neuropteris*, and the plant is a fern or perhaps a pteridosperm, and does not belong to the *Salisburia* family. Most of the specimens studied are comparatively small, and one, which had formerly been regarded as *P. expansum*, is now placed in a new species, *P. bifoliatum*. A. G.

Syniopteris.—M. ZALESSKY ("Sur le *Syniopteris Nesterenkoi* n.g. et sp. et le *Syniopteris Demetrian*a n.g. et sp., nouveaux végétaux Permien," *Bull. Acad. Sci. U.R.S.S., Leningrad*, 1929, sér. vii, 729-36, 4 figs.). An account of some impressions of fossil ferns from the Upper Permian on the Great Synia River, an affluent of the Oussa, in the basin of the Petchora. The fronds reveal different stages of development, and from them the author describes *Syniopteris*, a new genus, with two species hitherto not known, which are now described and figured. A. G.

Osmunda.—M. L. FERNALD ("Some Varieties of the Amphigean Species of *Osmunda*," *Rhodora*, 1930, 32, 71-6). In revising the North American species of *Osmunda* the author has come to the following conclusions: (1) The American form of *O. regalis* should be regarded as var. *spectabilis* Gray; (2) *O. Claytoniana* is a North American species, which has a var. *vestita* Milde confined to the Himalayas, the locality "Rio Janeiro" being a blunder made by Hooker and Greville; (3) *O. cinnamomea* has three varieties—var. *typica* belongs to temperate Eastern North America, var. *imbricata* Milde to tropical and subtropical Eastern America, var. *asiatica* Fernald to Manchuria, Sachalin, Japan, Yunnan, this being described as a new variety. A. G.

Pteridophytes of Lettland.—K. STARCS ("Einiges über die Verbreitung und Formenkreise der Pteridophyten Lettlands," *Acta Horti Botanici Universitatis Latvianensis, Riga*, 1929, 4, 77-88). An account of the Latvian pteridophytes critically determined, with recognition of forms, sports, hybrids, etc., a subsequent note by K. R. Kupffer being added, on p. 247, with reference to "*Equisetum trachyodon* A. Br. im Ostbaltikum"; and a note on p. 248, by N. Malta, confirms the finding of "*Botrychium simplex* Hitchc. in Lettland." A. G.

Bryophyta.

Peristome of Polytrichum.—R. VAN DER WIJK ("Über den Bau und die Entwicklung der Peristomzähne bei *Polytrichum*," *Recueil des Travaux Botaniques Néerlandais*, 1929, 26, 289-395, 43 figs.). The author set himself the task of determining the time and place of the first rudiments of the peristome of *Polytrichum*, the course of development of the peristome, the result of the development, the comparison of the peristome with that of the other Bryales. After a résumé of previous works on the subject, he gives an account of his own researches, made by means of numerous series of sections of capsules in various stages of development, and corrects the errors of former investigators. Incidentally, also, he has studied the structure of the seta in relation to that of the capsule, the longitudinal growth of the seta, the first division of the amphithecium, etc. A. G.

Splachnum.—HEDWIG BORNHAGEN ("Geschlechterverteilung und Geschlechtsdimorphismus bei *Splachnum ampullaceum* L. und *Splachnum sphaericum* (L. fil.) Swartz," *Beihefte Bot. Centralblatt*, 1930, **46**, 407-34, 20 figs.). The author discusses the sex-distribution and reproduction and the sex dimorphism in the *univalens*, *bivalens*, and *quadri-valens* states of *Splachnum ampullaceum*, and the similar aspects of the *univalens* and *bivalens* states of *S. sphaericum*, and she treats of the questions of haploidy, diploidy, and tetraploidy involved. A. G.

Dicranum Scottianum.—H. REIMERS ("Über *Orthodicranum Allorgei* Amann et Loeske, *Dicranum canariense* Hpe. und *D. Scottianum* Turn.," *Notizblatt Bot. Gart. und Mus. Berlin-Dahlem*, 1930, **10**, 942-5). The author calls attention to a misunderstanding of some species of *Dicranum*. They all belong to *D. Scottianum*, which comprises two subspecies, briefly defined here: (1) *anglicum*, found in Scandinavia, Britain, France; (2) *canariense*, found in the Atlantic isles and Spain. To the latter are referred *D. canariense* Hpe., *D. erythrodontium* Hpe., and *Orthodicranum Allorgei* Amann & Loeske. A. G.

Sphagnaceae of Archangel.—A. P. SCHENNIKOW and M. M. GOLUBEWA ("Beiträge zur Geographie und Oekologie der *Sphagnum*-arten im Gouvernement Archangelsk," *Bull. Jard. Bot. Principal de l'U.R.S.S., Leningrad*, 1929, **28**, 163-83). An account of 28 species of *Sphagnum*, collected in the neighbourhood of Archangel, the delta of the North Dwina, and Cholmogory; 13 of these are new records for the Archangel district, and 4 are new to the province of Archangel—*S. Angstroemii*, *S. lenense*, *S. obtusum*, *S. platyphyllum*. A new form of *S. Lindbergii* is described. The rest of the paper is concerned with the ecology of the various *Sphagnum* associations. A. G.

Oregon Hepaticae.—ETHEL I. SANBORN ("Hepaticæ and Anthocerotæ of Western Oregon," *Univ. Oregon Publication, Plant Biology Series*, 1929, **1**, 1-111, 5 pls.). Descriptions of the families, genera, and species of the hepatic flora of Western Oregon, with keys to the genera and species, and records of localities. The systematic account is preceded by an introduction with notes on the geographical features of Oregon, and a historical survey of the previous records of these plants in the state. About 70 species are described. A. G.

Himalayan Mosses.—H. N. DIXON ("Additions to the Moss Flora of the North-Western Himalayas," *Annales Bryologici*, 1930, **3**, 51-70). An account of the more interesting mosses collected by Kerr, Lillie, and others in Kashmir, Ladakh, Lahul and Chamba. The total number of species enumerated is 78, and among them are descriptions of 18 new species and 2 varieties. They come from localities ranging from 5,000 to 17,000 ft. For convenience a new species of *Merceyopsis* from Poona is included. A. G.

Waziristan Mosses.—H. N. DIXON ("Mosses collected in Waziristan by Mr. J. Fernandez in 1927," *Journ. Bombay Nat. Hist. Soc.*, 1929, **33**, 279-83). A list of about 35 mosses from Waziristan, constituting the first records from that country. They were gathered at altitudes ranging from 2,300 to 6,300 ft., and they are of Western Himalayan type. Among the novelties are a new species of each of the following genera: *Hymenostomum*, *Timmiella*, *Splachnobryum*, *Bryum*, *Brachythecium*. The fruit of *Barbula Ehrenbergii*, hitherto unknown, is described. A. G.

Thallophyta.

Algæ.

Origin of Diatoms.—A. A. KORSHIKOV ("On the Origin of the Diatoms," *Beihefte z. Bot. Centralblatt*, 1930, **46**, 460-9, 1 fig.). The author discusses the hypotheses which have been put forward by authors as to the origin of the diatoms, and describes some observations made by himself on the protoplasmic structure of *Attheya* and *Rhizosolenia*, from which he draws two conclusions:—(1) The cell sap of the Diatoms is a more or less concentrated solution of a substance apparently resembling the leucosin of the Chrysomonads; (2) Drops of this substance pressed out of the cell are covered with a very thin semi-permeable pellicle, which may be cytoplasmic in origin, or it may be a haptogen membrane. As regards the origin of the Diatoms, the occurrence of contractile vacuoles points to a descent from the Flagellatæ, as also does the occurrence of motile gametes in some of the centric Diatoms. The Centricæ are a group more primitive than the Pennatæ. On the other hand, the presence of leucosin as a store product shows the correctness of Pascher's view as to the affinity of the Diatoms and Chrysomonads, and as to the frustule of the Diatoms speculation suggests that it hints rather at the siliceous armour of the motile Chrysomonads than at the bivalvular wall of a resting cell, such as the cysts in Heterocontæ.

A. G.

Ceylon Diatoms.—B. W. SKVORTZOW ("Notes on Ceylon Diatoms, I," *Ann. Roy. Bot. Gard., Peradeniya*, 1930, **11**, 252-60, 3 pls.). A list of nearly a hundred forms of diatoms in mud samples collected by A. H. G. Alston in 1926. The diatoms extracted are mostly tropical in character, being of Indo-Malayan type. The presence of *Cerataulus thermalis* and of its var. *sinensis* is of great interest, the variety being known from China and from the island of Socotra. Among the freshwater species a number of brackish water diatoms were observed. The novelties are 5 species, 11 varieties, and 9 forms.

A. G.

Pyrenoids in Heterocontæ.—A. A. KORSHIKOV ("On the Occurrence of Pyrenoids in Heterocontæ," *Beihefte z. Bot. Centralblatt*, 1930, **46**, 470-8, 2 figs.). The author describes his observations and experiments in demonstrating the occurrence of pyrenoids in *Bumilleria* and *Botrydium*. Thus in the Heterocontæ rudimentary pyrenoids exist; they have been demonstrated also in some Chrysomonads and diatoms, and this bears out Pascher's view as to the relationship of these groups, which at first sight are so heterogeneous.

A. G.

Mosquitoes and Algæ.—LUCY J. HOWLAND ("Bionomical Investigation of English Mosquito Larvæ, with Special Reference to their Algal Food," *Journ. Ecology*, 1930, **18**, 81-125, 10 figs.). Eight ponds near Farnham Royal were visited, and the food contents of 1,032 mosquito larvæ captured in the ponds were examined; the frequency of occurrence of the various algæ found in the guts of the larvæ were noted. Tables of the algæ so found in the various species of mosquitoes in the various ponds are set forth, with their frequencies. The species of larvæ found in a given pond seemed to be related to the algal flora, but without showing any decided preference for any one kind of food; some of the larger species of larvæ occurred in ponds having a large algal growth, such as *Mougeotia* and *Hyalotheca*. Apparent correlations were noted between the spring and summer phases of algæ and the appearance of the larvæ.

A. G.

Esthonian Freshwater Algæ.—H. SKUJA ("Süßwasseralgen von den westestnischen Inseln Saaremaa und Hiiumaa," *Acta Horti Botanici Universitatis Latviensis, Riga*, 1929, **4**, 1-76, 3 pls.). An enumeration of the freshwater

algæ collected on two large Baltic islands during a short excursion of ten days. In all, 580 species and varieties are recorded, among these being 60 Flagellatæ, 23 Dinoflagellatæ, 92 Cyanophycæ, 145 Chlorophycæ, 14 Heterokontæ, 40 Zygnemacæ, 196 Desmidiacæ, 5 Rhodophycæ, and 2 of uncertain position. Among these, five species, four varieties, and three forms, are described as new. A. G.

American Algæ.—ETHEL M. POULTON ("Further Studies on the Heterokontæ: Some Heterokontæ of New England, U.S.A.," *The New Phytologist*, 1930, **29**, 1-26, 4 figs.). An account is given of the following algæ:—*Stipitococcus urceolatus*, *Botrydiopsis minor*, *Chlorobotrys stellata* and *C. regularis*, *Bernardinella bipyramidata*, *Characiopsis*, *Ophiocytium*, *Botryococcus Braunii* and *B. protuberans*, *Tribonema*, *Bumilleria sicula* and *B. exilis*, *Botrydium granulosum*, also of the method of culture in each case. A. G.

Algæ of Steppes.—N. N. WORONICHIN ("Materialien zum Studium der Algen-Vegetation in den Seen der Kulundin Steppe," *Bull. Jard. Bot. Principal de l'U.R.S.S.*, Leningrad, 1929, **28**, 12-40, 6 figs.). The material was gathered on the Kulundin Steppe, in the Province of Tomsk, and was obtained from 20 lakes, the majority of which were more or less alkaline with Na_2CO_3 , a few were brackish with NaCl , and two were purely freshwater. Examination showed the algal vegetation of these lakes to be correspondingly very peculiar. In three of them was a colossal development of *Phormidium tenue* and *Aphanocapsa salina*, due to a strong deposit of organic matter. Another lake had a water-bloom of two new species of *Anabaenopsis*; while yet another lake produced a water-bloom in which was detected a new genus of algæ—*Lochmiopsis*, belonging to the group Leptosireæ. The systematic list contains a total of 61 species, exclusive of diatoms, and 43 of these were collected in strongly mineralised waters, 26 of them being Schizophycæ. A. G.

Salt Lakes of Steppes.—N. N. WORONICHIN and A. G. CHACHINA ("Zur Biologie der Salzseen in der Kulundin Steppe," *Bull. Jard. Bot. Principal de l'U.R.S.S.*, Leningrad, 1929, **28**, 149-62, 10 figs.). A description of the algal vegetation of six mostly bitter salt lakes on the Kulundin Steppe, in the Province of Tomsk, in West Siberia. The total number of algæ found was 23 species, 16 of which are Schizophycæ, yielding, among other novelties, one genus new to science—*Dzensia*. Some species develop themselves in colossal numbers, for example, *Dzensia salina*. A. G.

Physodes of Phæophycæ.—MARIUS CHADEFAUD ("Les physodes des Phéophycées, leur coloration vitale et leur structure," *Bull. Soc. Bot. de France*, 1929, **76**, 777-80). The author discusses the mechanism of the living colouration of the physodes, and the morphology and structure of these bodies. He objects to Hansteen's name for them, "grains de fucosane," which, as Mangenot has shown, should be suppressed. A. G.

Iodine of Marine Algæ.—PIERRE DANGEARD ("Contribution à la connaissance du cycle de l'iode chez les Algues marines," *Le Botaniste*, 1928, ser. xx, fasc. iii, 69-115). The author gives a historical account of what has been recorded in the past about the presence of iodine in marine algæ, and then describes his own researches among algæ in Brittany. He demonstrates that there is an emission of free iodine during normal life by certain species of *Laminaria* and *Fucus*. The emission of volatile iodine can be proved by the use of starch paper held at several centimetres of distance from brown algæ exposed at low tide. Iodine can also be demonstrated in the water immediately surrounding the algæ. The process of emission of iodine goes on continuously, during day and night apparently;

but as it comes from the epidermal layer where photosynthesis goes on, there may be a relation between it and the chlorophyll function. In specimens of *Laminaria* and *Fucus* taken from the sea, the volatilisation of iodine goes on until the plants are dead. It is therefore advisable to kill the algæ as soon as possible, if the purpose is to extract the maximum quantity of iodine from the material. There are several points yet to be investigated, as whether the fruiting season affects the production of iodine. Usually the species of *Laminaria* which contain the largest percentage of iodine emit the most iodine; but *Saccorhiza* appears to be inert. Some species of *Fucus* emit iodine actively, but others not at all, and the Floridæ, though some of them are known to have iodine-cysts, appear to be inactive. We are ignorant of the form in which iodine exists in sea-water and penetrates into algæ. The liberation of free iodine appears to be a process of oxidation, and probably is connected with the photosynthesis in the epidermal cells. A. G.

Algæ of Banyuls.—J. FELDMANN ("Note sur quelques Algues marines de Banyuls," *Bull. Soc. Bot. de France*, 1929, **76**, 785–93, 2 figs.). A preliminary note on the marine algæ of Banyuls, with systematic and ecologic notes on some of the more interesting species. Among the nine species discussed are *Halicystis ovalis*, *Erythroglossum Lenormandi*, *Asparagopsis armata*. A. G.

Marocco Algæ.—A. RAPHÉLIS ("Algues du Maroc récoltées par M. J. Gattefossé," *Bull. Soc. Bot. de France*, 1929, **76**, 719–30). A list of over 130 species of algæ collected on the coast of Marocco, with their localities and the collector's numbers. They are mostly of the European Atlantic type, but an infiltration of tropical species is noted for the southern localities. A. G.

Fungi.

Study of Phytophthora.—M. J. NARASIMHAN ("Studies in the genus *Phytophthora* in Mysore," *Phytopathology*, 1930, **20**, 201–14, 5 text-figs.). The author has made a study of sexuality in the above genus, and for his purpose has made cultures of *Phytophthora Areca* along with strains of the same fungus on seven other hosts—*Santalum*, *Loranthus*, *Jatropha*, etc. He claims to have definitely established that these different strains are either male or female, and has demonstrated that the union of the different mycelia—if properly paired—results in the formation of oospores or of antheridia. The view is held that oospore formation is the result of the fusion of heterothallic strains from different hosts; thus *Areca* and *Loranthus* are invaded by the male mycelia, *Santalum* and *Jatropha* strains by the female mycelia. He explains the absence of oospore formation in some species as due to the lack of one or the other sexual strain. A. L. S.

Additional Hosts of Synchytrium endobioticum (Schilb.) Perc.—MARY S. MARTIN (*Ann. Appl. Biology*, 1929, **16**, 422–9, 2 pls.). The method which proved successful in inoculating plants other than potato was by means of "green warts," the small tubercles which enclose the summer sporangia of the fungus; these were taken from Arran Chief potatoes, where they are produced abundantly on young shoots. Numerous species of Solanaceæ were thus infected, though the same plants were unaffected by contaminated soil. The warts were ground down, mixed with sand, and applied to the collar of the experimental plant. As a result, infection was secured in five new *Solanum* plants, and thus a reliable method of obtaining the disease for experimental purposes was provided. A. L. S.

Genetics of Mucor.—SOPHIA SATINA and A. F. BLAKESLEE ("Criteria of Male and Female in Bread Moulds (*Mucor*)," *Proc. Nat. Acad. Sci.*, 1929, **15**, 735–40, 3 text-figs.). The authors discuss the problem of sex as applied to the

signification of the terms + and - in mucors. These terms have been applied to the gametangia, and it has been found that the reactions of the gametes is not determined by their chromosomal constitution alone. It has been gathered from the evidence that the + races are female and the - races male, owing to their biochemical reaction as compared with those of higher races. A. L. S.

Apothecial Development.—H. GWYNNE-VAUGHAN and H. S. WILLIAMSON ("Contributions to the Study of *Humaria granulata* Quel.," *Ann. Bot.*, 1930, 4, 127-45, 2 pls., 10 text-figs.). The material for research is a yellow-coloured discomycete very common on cow's dung. An account is given of the method of preparing the culture media and of inducing healthy growth. Spores do not germinate at once, but with the help of a heat-stimulus they germinated five months after they were shed—after seven months without the help of heat; they retain vitality over a year. There are + and - spores, and mycelia are without any growth or morphological distinction. Fusions take place between + and - hyphæ, which alone can produce archicarpus and oogonia. Development stops at that stage in the monosporous cultures. In fused cultures the oogonium gives rise to the ascogenous hyphæ: there is no antheridium. The young oogonium is crowded with nuclei, which fuse in pairs. Thereafter nuclear division takes place by karyokinesis, two divisions before the ascogenous hyphæ are formed, and one in the hyphæ during their development. The chromosomes were four in number. The ascus is derived from the penultimate cells of the ascogenous hyphæ with two nuclei that fuse to form the definitive nucleus of the ascus, which, on division, shows eight chromosomes, again reduced to four at the second division in the ascus. It was proved that the same ascus included both + and - spores. In the oogonium the nuclear fusion is considered to be apogamous. Heterothallism occurs which is not true sexual heterothallism, but well-developed nutritive heterothallism, while retaining recognisable evidence of sex. A. L. S.

Sex and Nutrition in the Fungi.—H. GWYNNE-VAUGHAN (*Brit. Ass., Section K, Botany, Glasgow*, 1928, 1-16). The paper was given as an address before the Botany Section of the British Association. It is a wide review of the origin and meaning of sex in fungi, taking in turn all the different families, with the phenomena peculiar to each group. Throughout, the existence of heterothallism is emphasised and its significance discussed: whether it is to be regarded as sexual or as partly nutritive. Examples are given where spores grown on appropriate media develop fruits without the intervention of heterothallism. There is also evidence that fusion, sexual or otherwise, may be connected with nutrition. It is hoped that further study of these fusion processes in fungi "may provide a clue to the significance of the primitive sexual fusion." A. L. S.

Study of Apothecia.—M. and MME. FERNAND MOREAU ("Le développement du Périthèce chez quelques Ascomycètes," *Rev. Gen. Bot.*, 1930, 42, 65-98, 7 pls.). In this paper the authors give the results of an extensive examination of species of Ascomycetes already studied by previous writers, and have found reason to disagree more or less with the conclusions arrived at. The species studied are *Pyronema confluens*, *Sphaerotheca Castagnei*, *Polystigma rubrum*, *Neurospora tetrasperma*, *N. sitophila*, and *N. crassa*. In their summary and conclusions they state that neither in fungi nor in lichens have they observed any fecundation at the origin of the fruiting body. In lichens there is no nuclear fusion in the ascogonium, and there is no functional trichogyne. It is only in the ascogenous hyphæ that the nuclei are paired—two in each cell; there is no evidence there of antheridial nuclei or fusion. They find, however, that there exists a heterothallic condition. Thus

in *Neurospora* they found the ascogonium with multinucleate cells producing ascogenous hyphæ with uninucleate cells, and remaining uninucleate until the formation of the bend at the tip of the ascogenous hypha: the procedure is the same in homothallic and heterothallic species. It is between the thalline hyphæ that anastomosis takes place. They find no fusion at the base of any Ascomycete.

A. L. S.

Perithecial Development in Erysiphe.—PANCA EFTIMIU and S. S. KHARBUSH ("Le développement des périthèces et le phénomène de la réduction chromatique chez les Erysiphacées," *Le Botaniste*, 1928, 20, 157-90, 7 pls.). The authors report the result of an extensive study of a number of genera and species in the family Erysiphaceæ. They have traced the nuclear history from the formation of the ascogonium to the ascospores, and they find the same phenomena occur equally in all the species. In conclusion they state that they have found no evidence of a double fusion: the sexual fusion occurs only once in the ascus which alone represents the diploid state—a reduced sporophyte. They found no trace of a second reduction in the ascus.

A. L. S.

Barley Mildew.—E. B. MAINS and S. M. DIETZ ("Physiologic Forms of Barley Mildew, *Erysiphe graminis Hordei* Marchel," *Phytopathology*, 1930, 20, 229-39, 3 text-figs.). The authors recount the work already done on this "Hordei" race of *Erysiphe graminis*. The aim of the paper is to further the knowledge of resistance of the host to the parasite. The work has included many inoculation experiments on various species of *Hordeum*. In five species they determined that they were not all uniformly favourable as hosts for the *Erysiphe*; in some there were both resistant and non-resistant varieties. The fungus also can be separated into races according to the hosts that it infects, and can be still further divided into five physiologic forms. Barley varieties have been found very resistant to all of these forms or strains, and other varieties are resistant to one or more.

A. L. S.

Study of Ascomycetes.—FRED. J. SEAVER ("Photographs and Descriptions of Cup-Fungi. X. *Ascotremella*," *Mycologia*, 1930, 22, 51-4, 2 pls.). *Ascotremella* is a new name given to the genus *Hamatomyces*, as the latter was used for a resinous substance that was non-fungoid. *Ascotremella*, as the name implies, is of gelatinous consistency very like an exudation; the apothecia are crowded and tremeloid, even the asci are swollen and the spores minute. The plants are brownish or raisin-coloured. Two species have been recorded in America.

A. L. S.

A New Trichoglossum.—J. W. SINDEN and H. M. FITZPATRICK (*Mycologia*, 1930, 22, 55-61, 1 pl.). While describing the new species, *Trichoglossum tetrasporum*, the authors have also given an account of the genus. It is distinguished by the presence of setæ on the outer surface, giving the plants a velvety appearance, thus differing from other members of Geoglossaceæ. A description of the new species is given, and comparison with other related species is made.

A. L. S.

Spores of Ascomycetes.—MARION CHILD ("Preliminary Studies in the genus *Daldinia*," *Ann. Miss. Bot. Gard.*, 1929, 16, 411-81, 1 pl.). In this paper the writer has studied spore-germination in *Daldinia* from every possible point of view. She found that in most cases viability persisted for about a year, that oxygen had no influence over germination, but that the spores failed to germinate in 1-10 p.c. pepsin solutions. Ultra-violet rays had a stimulating influence on frozen spores,

and high temperatures were generally stimulating. The effect of various culture media and of pH value is also discussed. Darkness was proved to be favourable to growth, and as regards mycelium a rather high rate of pH was favourable. Child concludes from the experiments that the physiological reactions of the fungi are correlated with their morphological characters.

A. L. S.

Russian Discomycetes.—ZOE GIRZITSKA ("Materials on the Discomycetes of Ukraina and Other Localities," *Bull. Jard. Bot., Kieff*, 1929, **10**, 54-67). The author collected the species listed mostly in the woods round Kiev. These are mostly mixed woods, covering more than 15,000 acres. The larger forms of fungi are well represented, as well as the more minute species, such as *Mollisia*, etc. Biological details are frequently added.

A. L. S.

New Localities for Cordyceps.—WANDA ZABLOCKA ("Über neue Fundorte einiger *Cordyceps* Arten," *Acta Soc. Bot. Pol.*, 1929, **6**, 187-91, 1 pl. Polish with German summary). *Cordyceps pistillariaeformis* was found at Moheno, the only record previously known being England, though the *Isaria* form has been found in the Far North. *C. Ditmari*, a very rare species, occurred, and always on *Vespa silvestris*. *C. sphingum* was collected in *Isaria* form; *C. militaris* was also collected.

A. L. S.

Macrophomina Cultures.—J. C. HAIGH ("Macrophomina Phaseoli (Mauhl.) Ashby and *Rhizoctonia bataticola* (Taub.) Butler," *Ann. Roy. Bot. Gard., Peradeniya*, 1930, **11**, 213-49, 7 pls.). The species *Macrophomina Phaseoli* has been determined as the pycnidial stage of *Rhizoctonia bataticola* which occurs in minute sclerotial forms in the tissues of herbaceous plants. The aim of the paper has been to follow the development of different strains from different hosts. Laboratory cultures and plant inoculations were undertaken. Twenty-seven strains of *Macrophomina* were examined and divided into three groups according to sclerotial size. Pycnidia have hitherto been associated only with the group of smallest sclerotia and only in nature. A saltation form developed which produced pycnidia in cultures: this form induces a rot of sweet-potato tubers, with the production of either pycnidia or sclerotia in the tissues of the host.

A. L. S.

Citrus Penicillium.—L. J. KLOTZ ("Some Microscopical Studies on *Penicillium* Decay of *Citrus*," *Phytopathology*, 1930, **20**, 251-6, 2 text-figs.). The examination was made by means of microscopical sections of the attacked fruit. It was observed that the hyphæ had no haustoria; they were intracellular as well as intercellular; they penetrated all cells, last of all the vesicles containing the juice. It was further noted that the hyphæ of the two species involved—*Penicillium digitatum* and *P. italicum*—collected under the stomata and thrust through the epidermis in that region.

A. L. S.

Smut of Sorghum.—C. H. FICKE and C. O. JOHNSTON ("Cultural Characteristics of Physiologic Forms of *Sphacelotheca Sorghi*," *Phytopathology*, 1930, **20**, 241-9, 2 text-figs.). The covered kernel smut of *Sorghum* is the most destructive disease of grain sorghums in certain districts of America. An examination of the fungus by means of cultures was carried out. The authors find in the species three physiologic forms, the difference being evident in the cultures, and also in inoculation experiments: the cultural characteristics seemed to be very stable. Sectoring in some of the cultures was a frequent occurrence, due probably to heterothallism.

A. L. S.

Study of Ustilago Zeæ.—G. VERPLANCKE ("Étude biométrique de quelques formes d'*Ustilago Zeæ* (Beck.) Unger," *Bull. Soc. Roy. Belgique*, 1930, **62**, 137-64, 3 pls.). The author has made a large series of artificial cultures, and has found great variation in the formation and appearance of the cultures—the size and form of the spores are also variable. He has compared his results with those obtained by other workers with other fungus spores. He decides that *Ustilago Zeæ* is particularly variable, and there is no correlation between the type of the spore and the appearance of the cultures. A. L. S.

Study of Oat Smuts.—GEORGE M. REED ("New Physiologic Races of the Oat Smuts," *Bull. Torrey Bot. Club*, 1929, **56**, 449-69). The paper gives an account of inoculation experiments with smuts on *Avena*: *Ustilago Avenæ* and *U. levis* were the smuts used. All the collections infected *Avena barbata*, and one race of *Ustilago Avenæ* attacked that species only. Loose smuts failed to infect an *Avena*; nearly all the covered smuts attacked it. Results are tabulated with regard to these and other experiments. It is concluded that specialised smut races have special significance in the problem of smut resistance inheritance. It is important in experiment to use known races of smuts and pure line material of the oat varieties. A. L. S.

Notes on Pennsylvania Ustilaginales, I.—GEORGE L. ZUNDEL (*Mycologia*, 1930, **22**, 97-100). The object of the paper is to record the occurrence of smuts in the State. The smuts found were species of *Entyloma*, *Sorosporium*, *Sphacelotheca*, *Tilletia*, and *Ustilago*, the last-named with several species and with a wide distribution, especially the species on *Oxalis*. A. L. S.

Systematy of Agaricus disseminatus Pers. — R. KÜHNER ("Le développement et la position taxonomique de l'*Agaricus disseminatus* Pers.," *Le Botaniste*, 1928, **20**, 147-56, 2 pls., 2 text-figs.). This well-known species was placed by Fries in *Psathyrella*, by other workers in *Coprinus*. Kühner, after a study of the development of the fruiting body, has concluded that this Agaric is in certain relations to both of the above genera, but with peculiarities that have induced him to place it in a new genus, *Pseudocoprinus*. A. L. S.

Biology of Wood Fungi.—S. R. BOSE ("Biology of Wood-Rotting Fungi common in Forest Areas," *Journ. Linn. Soc., Lond.*, 1930, **48**, 417-38, 4 pls., 1 text-fig.). Bose has given an account of a series of cultures of Indian Polyporeæ that are known to be wood and tree fungi, either saprophytes or parasites. The medium used was malt-extract agar, but it was observed that wood-rotting fungi could grow on a wide range of artificial media. Also he found that these fungi could grow on any tree unless there was some inhibitive substance in the woody tissues. The fungi cultured were species of *Trametes*, *Polyporus*, *Polystictus*, and *Ptychogaster*. Growth was induced in every case; frequently pores were formed, sometimes with spores. Bose worked with pieces of the fungus or with monospore cultures. He describes for each the course of development, the influence of gravity and of light as well as of temperature and humidity. He noted in these cultures that when the vegetative mycelium was vigorous, spore production was scanty or absent. He grew one species of *Ptychogaster*, and obtained a development of hymenial pores with spores, though basidia could not be seen. A. L. S.

Study of Saccoblastia.—DAVID H. LINDER ("The Life-History and Cytology of *Saccoblastia intermedia* n. sp.," *Ann. Miss. Bot. Gard.* 1929, **16**, 487-98, 3 pls.). *Saccoblastia* belongs to the order Auriculariales, and is divided into two subgenera—the one floccose or hypochnoid, the other gelatinous. The species in

question belongs to the latter subgenus. It was collected from a moist decaying stump at Soledad, Cuba. Examination showed that there was a joining of two hyphæ, taking the place of clamp connection, and thereafter clavate probasidia were formed, the seat of fusion between the paired nuclei. After a short resting stage the probasidium sends out a long hypha or promycelium, which enlarges to form the true basidium, and becomes 3-septate, each cell uninucleate, which nucleus passes into the spore. Linder considers this life-history supports the view that the Auriculariaceæ are derived from the Uredinales, the evolutionary change being due to the saprophytic mode of existence adopted. A. L. S.

Relation between Parasite and Host.—E. SCHAFFNIT and A. VOLK ("Beiträge zur Kenntniss der Wechselbeziehungen zwischen Kulturpflanzen, ihren parasiten und der Umwelt," *Phytopath. Zeitschr.*, 1930, **1**, 535-74, 14 text-figs.). This paper is a second contribution on the physiological reactions between fungus and host—an examination of a number of parasites with research on the varying conditions of the cells attacked. It was found that plants lacking nitrogen and phosphorus were not so susceptible as those in which these substances (with lessened potash) were abundant; these were severely attacked, while plants with a heightened phosphorus and potash content occupied a position midway as regards infection. These general results are supplemented by a detailed account of the experiments with the varying plants. A. L. S.

Belgian Fungi.—M. BEELI ("Notes mycologiques. Champignons nouveaux pour la Flore belge," *Bull. Soc. Roy. Belgique*, 1930, **62**, 127-32, 3 text-figs.). The author reports a varied series of fungi new to Belgium, but a few also new to science; the latter include *Peziza luteomarginata* from burnt soil, *Cladesiella meruloides* on decaying humus, and *Cortinarius radicans*, also on soil. A. L. S.

New or Noteworthy Fungi.—W. B. GROVE (*Journ. Bot.*, 1930, **68**, 65-74, 8 text-figs.; 97-102, 5 text-figs.). The paper is a continuation of previous notes by the author. The first part includes a considerable number of records of microfungi new to Britain, all of them described at length, with diagnoses of three new species, *Sordaria arenicola*, *Physalospora Lonicerae*, and *Didymosphaeria enormis*, the latter with very large 1-septate spores. The second part includes full descriptions of the species new to Britain, all of them microfungi, and growing on various living or dead leaves and stems. The record amounts to 11 species; one is new to science. A. L. S.

Fungi from Spain.—LUIS M. UNAMUNO ("Hongos microscópicos de los alrededores de La Vid, Burgos," *Bol. Real Soc. Esp. Hist. Nat.*, 1929, **29**, 387-402, 5 text-figs.). There are here recorded, from this district in Castile, a large number of microfungi belonging to many families. A number of species new to science are described, belonging to the Pyrenomycetes or to the *Fungi Imperfecti*. A. L. S.

Russian Mycology.—ZOE GIRZITSKA ("Materials to the Mycoflora of Ukraina," *Bull. Jard. Bot., Kieff*, 1929, **9**, 92-101; *op. cit.*, 1929, **10**, 4-40, 1 pl. Russian and English). The writer gives a description of the territory—"great pine and mixed woods, damp forests, and swampy meadows"—so far very little investigated for fungi. The list includes plants in practically all the families except Discomycetes, both of the larger fungi and of the smaller microfungi. The whole amounts to 1,000 species. In many instances biological and descriptive notes are supplied. A. L. S.

Fungi from the Congo.—M. BEELI ("Contribution à la flore mycologique du Congo : Fungi Goossensiani, VII," *Bull. Soc. Roy. Belg.*, 1929, **62**, 56–68, 1 pl.). Beeli continues his descriptions of species collected by Mme. Goossens in West Africa. He is dealing with the larger species, and along with many known forms he describes 12 new species, nearly all Polypores, of which diagnoses and drawings are given. The local native name is added in many instances. A. L. S.

Fungi from Somaliland.—ORESTE MATTIROLO ("Eumycetes in Emilio Chiovenda," *Flora Somalia, Sindei, Ital., Roma*, 1929, 358–69). The fungi were collected in a recent expedition to Somaliland by G. Stefanini and N. Puccione. Stefanini had collected fungi on a previous journey. The numbers listed and recorded amount to several hundred. They belong mostly to the larger species of Polyporeæ and similar woody types. One microfungus was collected, *Aecidium* sp., on leaves of *Cissus*, not determinable. A. L. S.

Fungi from Vancouver.—JEAN E. DAVIDSON ("Notes on the Agaricaceæ of Vancouver (B.C.) District—I," *Mycologia*, 1930, **22**, 80–93). The author states that there are two seasons when Agarics are abundant—from September till the end of the year, and from March to May (inclusive). She gives various notes as to slight biological differences, such as variations in size, colour, and taste. The white-spored Agarics are by far the most abundant, especially species of *Mycena*. In all, 81 species are described, being those that the author names with assurance. A. L. S.

Notes on Mycorrhiza.—J. COSTANTIN, J. MAGRON, VALERIE JAUDEL and P. SEBARD ("Influence de la culture sur les Plantes à Mycorrhizes," *Ann. Sci. Nat. Bot.*, 1929, **11**, 337–41). The authors have made observations on a series of cultivated plants, and find that many of them lack the mycorrhiza fungus that was associated with their roots in their natural habitats. They cite the potato: in the roots of the wild specimens they find the fungus, but not in the cultivated potato. They suggest that the difficulty of securing growth in many plants is due to the change of soil, transplantation having destroyed the conditions necessary to the healthy growth of the fungus. They even suggest that probably all the higher plants are intimately associated with some lower forms—bacteria, algæ, or hypogæous fungi. A. L. S.

Variation in Fungi and Bacteria.—W. B. BRIERLEY (*Proc. International Congress Plant Sci.*, 1929, **2**, 1620–54). The writer has set out to depict the seemingly inexplicable variations that occur in cultures of fungi and bacteria. These he classifies from two points of view: (1) on a basis of morphological and physiological criteria, and (2) genetic values as shown in appearance and behaviour. He has given an account of similar phenomena with their particular terminology in other groups of organisms which he considers may well fit fungi and bacteria also. He discusses the bases of variation under the headings of (1) cytology, (2) impure genetic material, and (3) cyclical developments. Under the latter group are cited the strains that may arise from hyphal or from spore inocula, sexuality and "sectoring" (discontinuous variation). He contrasts the latter with Galton's polygon or rearrangement of atoms in molecular structure. In conclusion, Brierley urges the importance of genetic research. A. L. S.

Origin of Fungi.—C. MERZ ("Versuch einer Stammesgeschichte des Pilzreiches," *Schriften d. Königsberg Gelehr. Ges. Naturwiss. Kl.*, 1929, **6**, 1–58, see *Bot. Centralbl.*, 1930, **158**, Lit. 98–9). The author rules out *Actinomyces* and *Saccharomyces* as possible progenitors of fungi, and any similarity of these to fungi he

considers to be due merely to convergence. Fungi he considers are to be regarded as monophyletic derivatives from Siphonocladiales (Chlorophycæ) and the Phycomyces, the earliest members from which the higher fungi are developed. The first appearance is traced to the Devonian. The writer has also worked out further developments. A. L. S.

Moss Mites as Spore-Bearers.—ARTHUR PAUL JACOT (*Mycologia*, 1930, 22, 94-6, 15 figs.). The subject has considerable bearing on the dissemination of plant diseases. Three types of mites are described. The author has found spores not only within the mites, but plentifully sprinkled over the body. He records also the occurrence of mites on tree trunks and herbs, and as the mites are plant feeders and puncture the leaves, there is much reason to consider them as disease carriers, though experiments have yet to be made to prove this. A. L. S.

Differential Staining.—R. H. STOUGHTON ("Thionin and Orange G. for the Differential Staining of Bacteria and Fungi in Plant Tissues," *Ann. Applied Biology*, 1930, 17, 162-4, 1 pl.). Careful and full descriptions are given by Stoughton as to the methods employed in tracing the advance of bacteria in cotton disease; the double stain has also been very valuable as a differentiating agent in a number of fungal parasites—*Peronospora*, *Phytophthora*, *Puccinia*, etc. The method followed is to stain first with carbol-thionin, then wash well and stain again with Orange G. A. L. S.

Mycorrhiza of the Alder.—E. PIESCHEL ("Ueber Pilze als Erlenbegleiter und über die Mykorrhizenfrage bei Erlen.," *Zeitschr. f. Pilzkunde*, 1929, 8, 23-28, 1 pl.). The author has observed that certain fungi regularly accompany alder trees, and chiefly *Lactarius lilacinus*, *L. cyathus*, and *Gyrodon rubescens*, the latter associated only with *Alnus incana*. These fungi have not been definitely proved as providing mycorrhiza for the roots by any synthetic cultures, but it is assumed with some certainty that they do provide the root-fungus. A. L. S.

Disease of Chestnut.—G. VERPLANCKE ("Une maladie intéressante du Chataignier," *Bull. Soc. Roy. Belgique*, 1930, 62, 105-7, 1 pl.). Chestnut disease due to *Endothia parasitica* was serious in the United States some years ago, and was detected in Belgium in 1924. The author of this paper describes a disease he discovered on chestnuts in 1928. Small distortions occurred on the branches, and these increase until the bark may be destroyed. The disease was identified with *Endothia*, but differing materially from the disease as described. In cultures a *Cytospora* was observed, and later the same *Cytospora* was discovered on old chestnut trees. *Cytospora ambiens*, the species in question, is the conidial form of *Valsa ambiens*. A. L. S.

Rye Disease.—H. HULSENBERG ("Das Auftreten der Weiss ährigkeit bei Roggen in Mitteleuropa in den Jahren 1928 und 1929, bewirkt durch *Leptosphaeria herpotrichoides* de Not.," *Zeitschr. Pflanzenkr. und Pflanzenschutz*, 1930, 40, 11-25, 1 text-fig.). The author has made a research into the occurrence and cause of the disease characterised by a whitening of the ears of rye due to the fungus *Leptosphaeria herpotrichoides*. He discusses the influence of climatic conditions and also of the soil. A severe attack was noted after a very cold winter. As to soil, the disease developed most rapidly on plants growing on acid soils, and manuring did not seem to produce much effect, though possibly the phosphorus content may have had some influence, and its use is recommended, along with lime, as a means of combating the disease. A. L. S.

Root Rot of Asparagus.—E. S. SALMON and W. M. WARE (*Gard. Chron.*, 1930, **87**, 275, 1 text-fig.). This disease of asparagus roots due to a pyrenomycete, *Zopfia rhizophila*, has been known on the Continent, but was first found at Evesham in this country. A second occurrence of the fungus is recorded from Penshurst, Kent. The roots become dark brown and die off. In the Kent specimen the host plants were noticed as failing in vigour, and the fungus was found on the roots, though its parasitism has been questioned. A. L. S.

Fungus Diseases of Crops.—G. H. PETHYBRIDGE ("Fungus and Allied Diseases of Crops, 1925, 1926, and 1927," *Misc. Publ. No. 70, Ministry Agric. and Fisheries*, 10, Whitehall Place, London, 1929, 1-75, 1 map, 2 text-figs.). The writer gives an account of weather and other conditions in England and Wales during the three years under review. The different kinds of attacks are published in sections according to the class of plants—such as cereals, potatoes, etc., on to ornamental and other plants—bulbs, corms, etc. The definite occurrences of each disease are noted, and advice given as to treatment. The popular names of diseases decided upon by a committee of the British Mycological Society have been used throughout. Pethybridge lists 23 parasites not hitherto recorded in this country. Non-parasitic diseases are also included in the survey. An index to the fungi is given. A. L. S.

Privet Anthracnose.—H. J. MIX ("Further Studies of Privet Anthracnose," *Phytopathology*, 1930, **20**, 257-61). This anthracnose is due to the sphaeriaceous fungus *Glomerella cingulata*. The research by means of inoculations proved that the fungus taken from apple or from privet can cause infection on other kinds of privet, but *G. cingulata* from both apple and privet failed to infect young branches of apple trees. A. L. S.

Human Skin Fungus.—RAFFAELE CIFERRI and BAILEY R. ASHFORD ("A New Porto Rico species of *Acremoniella*," *Mycologia*, 1930, **22**, 62-8, 2 text-figs.). The authors have described the fungus from cultures on agar: the hyphae are colourless, the conidiophores prostrate and unbranched, bearing at the tips somewhat large black opaque conidia. Notes on the classification are given. The fungus occurred on human skin at Porto Rico. A. L. S.

Bacterial Plant Disease.—WALTER KOTTE ("Eine bakterielle Blattfaule der Winter-Endivie," *Phytopathol. Zeitsch.*, 1930, **1**, 605-13, 5 text-figs.). Kotte describes a serious disease of the leaves of Winter-Endive, *Cichorium Endivia*, due to a bacterium which has been determined as *Pseudomonas Endiviae* n. sp. The bacterium gains entrance into the leaf following an attack of *Puccinia Cichorii*. Infections were induced through needle pricks of the leaf, and probably aphides carry the disease. An undamaged leaf could not be entered by the bacterium. A high degree of humidity was favourable to the disease. A. L. S.

Bacteria of Cotton Disease.—R. H. STOUGHTON ("The Morphology and Cytology of *Bacterium malvacearum*," *Proc. Roy. Soc.*, 1929, B, **105**, 469-84, 2 pls., 2 text-figs.). The study has been undertaken to determine the character and significance of certain deeply-staining bodies within the bacterial cell. Hitherto the presence of reproductive bodies has been denied, multiplication being considered as due solely to fission. Stoughton, by his careful staining methods, has demonstrated a central structure connected with cell-division, as also small deeply-staining granules formed in the cell wall and liberated by extrusion. These bodies resemble, he says, the "gonidia" of other writers. The presence of spherical coccus-like bodies and also of "giant-cells" in old cultures is described. (The term

"gonidia" is rather startling: it was coined by Wallroth (1824) to signify the green algæ in the lichen thallus, under the impression that they were reproductive bodies, and has been in use since his day to denote these lichen algæ.) A. L. S.

Fungi from Sumatra.—K. B. BOEDIJN ("Beitrag zur Kenntnis der Pilzflora von Sumatra," *Recueil trav. bot. Neerl.*, 1929, 26, 396–439, 17 text-figs.). Boedijn notes that previously the study of Eastern fungi had been confined to Java; from Sumatra only 55 had been recorded. Most of the present contribution is due to his own collecting, the new list numbering 142 species, only a few being repeated from previous findings. Along with the larger fungi there is included a fine series of Hyphomycetes, new and old. Only a few parasites are given. A number of new species are described. A. L. S.

Lichens.

New Italian Lichens.—CAMILLO SBARBARO ("Licheni italiani nuovi o interessanti," *Arch. Bot. Sist. Fitog. Genet.*, 1930, 6, 9–15). Most of the species enumerated were collected by Sbarbaro chiefly in Liguria. A considerable number are new to science, and have been determined by Dr. M. Bouly de Lesdain. The diagnoses are here republished. A. L. S.

Thallus of Verrucaria.—E. BACHMANN ("Der Lagerbau bei *Verrucaria*," *Ber. Deutsch. Bot. Gesellsch.*, 1929, 47, 554–60, 1 text-fig.). Bachmann gives us an anatomical study of the thallus of two species of *Verrucaria*—both of them epilithic in character—developing on the surface of the substratum. The first, *V. acrotella*, has a scanty broken thallus, but with superficial hypothalline strands. The specimen described grew on limestone, but in no case did it penetrate the substratum. The thallus is extremely thin, and the gonidia are more or less scattered. *Verrucaria pingicula*, exclusively calcareous, is epilithic. It has a continuous thallus spreading over the surface: there is a distinct gonidial zone and cortex, the gonidia frequently in close clumps. The rhizoidal hyphæ alone pierce the calcareous substratum; but they do not develop sphaeroid cells or oil hyphæ, and carry with them no gonidia. They do, however, dissolve the rock. A. L. S.

Danish Cladoniæ.—H. MØLHOLM HANSEN and MOGENS LUND ("De Danske arter af Slægten *Cladonia*," *Bot. Tidsk.*, 1929, 41, 1–80, 4 pls., 37 text-figs.). The authors, in a short preface, give a review of work on *Cladoniæ* in Denmark, the earliest reference being to Branth and Rostrup (1869). A short account is given of the genus—the types of thallus and of fructification. A synopsis is given of the groups, followed by a key to the species. Further help to identification is provided by a synoptic grouping of species for each section. The geographical distribution is given as well as the locality in Denmark, and the habitat is in all cases noted. Forty-five species are listed for Denmark. A. L. S.

Monograph of Acarospora.—A. H. MAGNUSSON (*K. Svenska Vetensk. Handl.*, 1929, 7, 1–400, 18 maps). Magnusson here includes, in a completed whole, the various works he has issued from time to time on the world-wide genus *Acarospora*. The preface gives a general account of the composition of the paper, then follows a description of the genus—the diagnosis and synonymy—followed by a long systematic discussion and by an account of the thallus and fructifications. Ecology also is taken into consideration: almost all *Acarosporæ* are rock dwellers, more or less nitrophilous, and living by preference on steep or overhanging rocks. Under distribution he gives the species to be found in each part of the world: those that are universal and those restricted to certain countries. The genus numbers 199 species, many of them determined by Magnusson himself, and all of them studied

by him when at all possible. The descriptions are full of necessary detail, the habitats are given, and the frequency of each species. The maps give in a graphic manner the particular distributions (Atlantic, Arctic, etc.) of a number of species. A complete index is also provided.

A. L. S.

Lichen Gonidia.—OTTO JAAG ("Recherches expérimentales sur les gonidies des lichens appartenant aux genres *Parmelia* et *Cladonia*," *Bull. Soc. Bot. Genève*, 1929, **21**, 1–119, 6 pls. 5 text-figs.). Jaag gives an account of a long and varied series of experiments on the growth of lichen gonidia in artificial cultures. He explains his methods of securing the purity of these cultures, the nature of the media, the influence of light, pH values, nitrogen, etc. His observations have all been made on the algæ in laboratory cultures, though they were also examined *in situ*; he found, for example, that in *Parmelia* the gonidia tended to a round form, in *Cladonia* were more frequently ovoid, though these characters were constant in neither. Differences in size were noted between the gonidia of different species. Gonidia varied in size, even in one specimen of *Cladonia furcata*, those of the squamules being smaller than those at the tips of the podetia, and the latter distinct in their containing oil-drops. The influence of light was closely associated with, and dependent on, the nature of the medium—in a "sugar" medium there was more abundant development in the absence of light, but either in light or darkness the algæ retained their green colour. *Cladonia* algæ were cultured from five different species, and the author notes that gonidia in the cultures from one genus of lichen differed from those of another genus to a larger degree than between different species of the same genus. The same problems were studied in the gonidia of *Parmelia* on six species. In the cultures all of them were recognisably distinct from those of *Cladonia*. The influence of temperature was specially observed—the lowering of the temperature to zero and below did not hinder development. The cultures were frozen and then melted without harmful effect on the algæ, and without influence on the multiplication by autospores and zoospores, but at 5° zoospores were less frequently formed. At 23° there was no development. In all the cultures increase was mainly by means of autospores—4, 16, 32 or more in each mother-cell—but in all the cultures zoospores were also formed, and these at low temperature; any added heat stopped movement. He also noted the formation and copulation of gametes, both isogametes and heterogametes, which he looks on as a sexual process. In classifying the species that have been differentiated in the cultures, he follows Waren in his grouping of them under two subgenera, *Eucystococcus* (5 species), with autospores to the number of 16 or fewer, and *Eleuterococcus* (6 species), in which the number may rise to 250. Jaag gives his own diagnosis of the lichen gonidium as globose or ovoid, with a cellulose wall and central chromatophore containing a pyrenoid; the chromatophore may be stellate or of irregular form, with a nucleus lying in an irregularity. He was unable to compare his cultured species with those of Waren. He describes eight new species, all from *Parmelia*. He is not convinced that the lichen gonidium is the *Cystococcus* described by Naegeli. In conclusion he draws attention to several deductions: that the gonidia of one genus differ from those of another, and that each lichen genus or species seems to be associated with one peculiar to itself. Thus *Parmelia*, he finds, is distinguished not only by morphological characters, but by the particular Parmelian gonidium. Again, he notes in *Parmelia* that it was possible to develop the gonidia without hydrocarbon nourishment: that is evidently related to the growth position of *Parmelia* spreading over the substratum and using decaying organic matters with which they are closely associated. *Cladonia* gonidia differed from those of *Parmelia* in several of these characteristics.

A. L. S.

Lichens from Italian Somaliland.—MARIA CENGIA-SAMBO ("Lichenes in Emilio Chiovenda," *Flora Somalia, Sindic., Ital., Roma*, 1929, 340-57). The author gives a general account of lichens determined previously from Somalia. The present collection includes a number of species with varieties, one of which is new to science. The specimens were mainly crustaceous, and were found on geological samples and on Phanerogams, hence the large number of Graphidaceae (corticolous) and of Blue-green species (saxicolous). The climate is tropical and dry, and the lichens characteristic of such a region. There were 34 saxicolous species, which, with two exceptions, were associated with the blue-green algæ *Scytonema*, *Glæocapsa*, *Xanthocapsa*, *Chroococcus* and, rarely, *Nostoc*. They were representatives of 10 genera of Pyrenopsidaceæ and 4 genera of Ephelaceæ. These lichens grew chiefly in the Migurtina region, extremely arid and exposed to the influence of the monsoon. The author suggests that algæ and lichen spores are brought by these winds to the calcareous and uneven rock surfaces. A. L. S.

New Lichen Genera.—EDOUARD FREY ("Drei neue Flechtengattungen," *Ber. Schweizer. Bot. Gesell.*, 1929, 38, 43-61, 7 text-figs.). The author found the first of these—*Lecanorella*—in Auvergne. It is distinguished by the cellular character of all the tissues—the crustaceous thallus, the apothecial margin, and hypothecium. The gonidia are minute, resembling *Dactylococcus* or some reduced form. *Toniniopsis*, which occurred in the Swiss National Park, has also minute gonidia, the apothecia are lecideine and plectenchymatous, the spores elongate, 3-septate and colourless. *Lecanephebe Meylani*, also new, was collected by Ch. Meylan on the Aiguilles de Baulmes. It is marked by highly-developed thalline strands with dense cell rows. The specimens were abundantly fruited, the apothecia growing on the sides of the thalline branches. In a final note Frey pleads for more exact anatomical details of minute lichens. He considers that the closer the relation between gonidia and hyphæ—as in the plectenchymatous thallus—the more developed is the symbiotic nature of the plant into a distinct organism. A. L. S.

Study of Teloschistes.—JOHANNES HILLMANN ("Studien über die Flechtengattung *Teloschistes* Norm.," *Hedwigia*, 1930, 69, 303-43, 2 text-figs.). The author gives a historical sketch of the genus, and describes the general structure and spores. Systematy, however, forms the principal theme. He follows Zahlbruckner in placing the species in two groups—*Euteloschistes* with 1-septate spores, *Niorma* with 3-septate—14 species in all. As far as possible he has dealt with type species, and the descriptions and notes are detailed and full of interest. He suggests that *Physcia megara* and *Chlorea flexuosa* may yet find a place in the family Teloschistaceæ. A. L. S.

Study of Cyphelium.—GUNNAR NILSSON ("Bemerkungen über *Cyphelium Notarisii* (Tul.) Blomb. et Forss. und *C. tigillare* Ach.," *Bot. Not.*, 1930, 105-28, 3 text-figs.). The author has proved that the above two species are distinct, mainly in the difference in spore septation—submuriform in *C. Notarisii*, constantly 1-septate in *C. tigillare*. The latter is widely distributed in Sweden. *C. Notarisii* is restricted and rather rare. Scandinavian localities for both are given and are indicated in the map. A list of literature, with references to the two species, is appended. A. L. S.

Stereocaulon.—CARROLL W. DODGE ("A Synopsis of *Stereocaulon*, with Notes on Some Exotic Species," *Ann. Crypt. Exot.*, 1929, 2, 93-153). Dodge has included in the synopsis the specimens from Costa Rica. Along with a synoptic

key he has gone over the species with many critical and explanatory notes. He has made use of the cephalodia as a diagnostic character both of their form and of the type of alga present, and also of the form of the squamules. The species listed are those accepted in Zahlbruckner's Catalogue of Lichens. A. L. S.

Systematic Notes on Lichens.—V. GYELNIK ("Lichenologische Mitteilungen, 8, 19," *Mag. Bot. Lap.*, 1929, 57-65, and 173-5, 1 text-fig. Hungarian and German or French). Gyelnik here publishes a series of his notes and observations. He has decided that the name *Parmelia rosæformis* must supplant *P. sulcata* Tayl., that *P. subconspersa* is worthy of specific rank, and that *P. Bornmülleri* Zahl. is the same as *P. glabra* Nyl. He has added new forms to many *Peltigera* species. In the second paper he discusses the various forms of *Parmelia verruculifera* which he regards as only development or growth forms. A. L. S.

Swiss Lichens.—EDOUARD FREY ("Flechten," *Ber. Schweizer. Bot. Gesell.*, 1928, 37, 110-24). In this publication there are a considerable number of species recorded new to Switzerland, many of them with full descriptions and systematic notes after careful microscopic study. ("Flechten," *op. cit.*, 1929, 38, 107-21.) Frey gives a list of papers directly concerned with Swiss lichens, and then lists the lichens that are new to Switzerland or that have been found in new localities. Frequent anatomical and biological notes are given, and special attention is devoted to *Gyrophoræ*. The Swiss species are fully described as to occurrence and habitat, and several of them with full diagnostic characters. A. L. S.

Lichens from Alaska.—G. K. MERRILL ("A New List of Alaskan Lichens in the genus *Cladonia*," *Bryologist*, 1929, 32, 41-50). The manuscript of this paper was found among the effects of G. K. Merrill after his death. The material had been submitted to him by L. J. Palmer, who made an extensive economic survey as to the food of the reindeer, lichens figuring largely as forage plants. Merrill has listed 67 species of *Cladonia* and varieties. Practically all of them are alpine in character. Special attention is given to the habitat. *Cladonia digitata*, on rotting wood, reported from Port Clarence, is described as common in temperate climates, but rarely found in the Arctic. A. L. S.

Lichens from Porto Rico.—A. ZAHLBRUCKNER ("New Species of Lichens from Porto Rico, III," *Mycologia*, 1930, 22, 69-79). The lichens were collected by the late Prof. Fink, and the paper is one of a series. A. Zahlbruckner describes 22 species belonging to many different genera and all new to science. With the exceptions of *Ramalina Finkii* and *Usnea Finkii*, they are all crustaceous forms. There are several representatives of "blue-green" genera. A. L. S.

Moraine Lichens.—C. F. E. ERICHSEN ("Die Flechten des Moränengebiets von Ostschleswig," *Verh. Bot. Ver. Prov. Brandenb.*, 1928, 70, 173-223; *op. cit.*, 1929, 71, 85-129; *op. cit.*, 1930, 72, 1-68, 5 pls.). The first contribution to this paper was published in 1928; the whole series has now been issued. The later papers deal with the listing and classification of the lichens. Diagnoses of known species are not reprinted, but the descriptions of form, occurrence, locality, etc., are full and very informing, making the whole paper a valuable work of reference. Among other species Erichsen has established *Lecanora pityrea* a variant of *L. conizaea* or of *L. varia*, but closely allied and distinguished mainly by the thickish sorediate margin of the apothecia. The many forms of species in all the genera are carefully delimited: thus for *Parmelia saxatilis* four varieties and one form are described; for *P. sulcata*, four forms. A. L. S.

Influence of *Usnea* sp. on Trees.—JOHN F. V. PHILIPPS ("The Influence of *Usnea* sp. (near *barbata* Fr.) upon the Supporting Tree," *Trans. R. Soc., S. Africa*, 1929, 17, 101-7). The crowding of *Usnea* on trees was most marked on species of *Podocarpus* and on living rather than on dead trees. Philipps describes cases of parasitism due to the *Usnea*, the harmful influence being seen in the sickly appearance and degeneration of the buds and young shoots. The best preventative he advises against excessive lichen growth is the "canopy" of the forest, as lichens do not flourish in dense shade. A. L. S.

Lichens.—H. G. WILLIS (*Ann. Rep. & Trans. Manchester Microscop. Soc.*, 1928, 1-18). The writer has reviewed all aspects of lichen plants—history, structure, physiology, economic uses. A. L. S.

Official Lichens.—C. C. PLITT ("Lichens Occurring upon Official Drugs," *Proc. Intern. Congress Pl. Sci.*, 1929, 2, 1382-4). The best-known study of "official lichens" is that of Fée, published in 1824, and the bark studied by him was mainly *Cinchona*. His object was to find if the epiphytic lichens affected the quality of the drug. Plitt's study has a wider range of outlook and of material. Four of the trees belonged to the United States—*Cascara sagrada*, *Cinchona*, *Granatum* and (possibly) *Cinnamomum*. He had already observed that certain lichens do favour certain trees, and he found that the lichen sure to be found on *Cascara sagrada* is *Thelotrema lepadinum*, and probably each tree has its peculiar dominant epiphyte. Much study is, however, necessary to find out whether the habitat or the position on the bark influences the kind of lichen to be found. Crustaceous forms are the most abundant. A. L. S.

Eastern Lichens.—A. N. OXNER ("Zur Systematik der Gattung *Lecania*," *Bull. Jard. Bot., Kieff*, 1929, 9, 62-3; "Ueber *Ramalina Rjabuschinskii* Sav.," *tom. cit.*, 82-6, 4 text-figs.). In the first paper Oxner describes a new species of *Lecania* from Central Asia and also incorporates in the genus *Lecidea expallescens* Nyl. In the second paper he gives an account of *Ramalina Rjabuschinskii* Sav., found by Savicz, in 1914, in Kamtschatka, but since that date determined by Du Rietz as a synonym of *R. Almqvistii*. Oxner shows that they are distinct—that the one has a loose medulla, and the other a compact central strand. A. L. S.

Northern Lichens.—A. N. OXNER ("Etwas über die Flechtenflora der Tschuktschen Halbinsel," *tom. cit.*, 87-91, 1 text-fig. Russian with German summary). A list of 17 lichens collected by K. J. Luchs on the peninsula of Tschuktschen, north of Kamtschatka. The list includes *Siphula ceratites*. As of especial interest Oxner notes *Cetraria kamezatika*, previously found in Kamtschatka. *Cetraria cucullata* and *C. nivalis* very distinctly bore pseudocypellæ. The lichens were collected on the tundra. A. L. S.

Somerset Lichens.—W. WATSON ("The Lichens of Somerset," *Somerset Arch. & Nat. Hist. Soc.*, Taunton, 1930, i-iv, 1-94). Watson has published the result of 20 years' expert collecting and examining of the Somerset lichens. In Dawson Turner's "Botanical Guide" Somerset was credited with about a dozen lichens, whereas the number has now been increased to over five hundred, and the list lays no claim to completeness. A historical account of earlier workers and their collections are given. Eight species have been recorded only in this county, and many rare species have been added to Somerset. As a rule, only locality and habitat with first records are given, but interspersed are useful critical notes, and a list of the fungi parasitic on these lichens is given. An index to the genera completes the paper. A. L. S.

Lichen Development.—A. N. DANILOV ("Introduction à la Synthèse du lichen *Leptogium Issatschenkoi* Eleuk.," *Bull. Jard. Bot. Princ. U.R.S.S.*, 1929, **28**, 225–64, 2 pls., 12 text-figs. French résumé). Danilov has given a well-illustrated account of the artificial culture of this *Leptogium*, which has been carried out by him in the laboratory during four years. He got the best growth results with a nutritive solution and agar. A humid atmosphere was unfavourable, and induced a tendency to an upright condition. The laboratory atmosphere was satisfactory. In these conditions the culture grew with the same rapidity as the *Nostoc* alone. If only a few shreds of hyphæ and algæ were present, revival of the plant was possible. Light was all-important, either sunlight or electric. A constant humidity induced a wart formation in place of flattened squamules. It is the mucilaginous mass of the *Nostoc* that serves as nourishment for the hyphæ. At the first stages the alga is dominant, equilibrium follows, and finally the fungus dominates, forms the cortex and produces the fructification. The hyphæ also form thalline outgrowths. If the symbiotic union is enfeebled, the gonidia may develop purely algal colonies as long as the alga is vigorous and young; with age this vigour declines. Finally Danilov finds that the growth represents a condition of mobile equilibrium.

A. L. S.

Symbiotic System of Lichens.—A. A. ELENKIN ("Sur les principes théoriques servant à détailler les rangs essentiels du système, combinatif des Lichens," *Bull. Jard. Bot. Princ. U.R.S.S.*, 1929, **28**, 302–5. French résumé). The lichen plant being the result of the combination of two different organisms, Elenkin has propounded an elaborate theory as to the influence exerted by one on the other, resulting, finally, in the production of essential types of growth consequent on the union of two variable and independent plants.

A. L. S.

Classification of Lichens.—A. A. ELENKIN ("Sur certain conséquences du principe combinatif dans le système des Lichens," *tom. cit.*, 442–5. French résumé). Elenkin has here postulated a somewhat complicated system expressing his views on the classification of lichens. He recognises the two different organisms he has to deal with, one represented by the already stable fruiting bodies, the other by the vegetative form—a product of the combination. He gives these different representants a certain definite status in his system, and from that works out the preponderating characters that determine the classification of the symbiotic plant. The fructification had been established before the combination: the thallus is a product of new conditions. Elenkin's final pronouncement describes the mutualism thus—"A homogeneous mycelium under the influence of symbiosis with algæ, and the direct action of the air has established the essential growth types."

A. L. S.

Mycetozoa.

Sclerotia of Mycetozoa.—MARCEL BRANDZA ("Observations sur quelques Sclérotés de Myxomycetes calcarées," *Le Botaniste*, 1928, **20**, 117–46, 16 text-figs.). Brandza has described the characteristics of the sclerotia of (1) *Fuligo septica*, which occurs in "cords" covered with lime crystals and composed of separate "spherules" varying in form; (2) *Badhamia capsulifera*, sclerotia of a red-brick colour and small, 3–4 mm. \times 1–2 mm., also composed of "spherules" with yellow calcareous granules; (3) *Badhamia macrocarpa*, the sclerotia larger and also calcareous; (4) *Physarum pulcherrimum*, deep purple in colour, 3–5 mm. in diameter; and *Didymium difforme*, the sclerotia of which measure only 2–3 mm. in diameter. These are all carefully described. In general, Brandza notes that the colour of the sclerotium is always darker than that of the plasmodium, to which the "spherules," however, correspond more nearly. The sclerotisation of the

plasmodium is quickly achieved, rarely longer than 3-4 hours, or even as low as 1 hour (*Didymium complanatum* and *Leocarpus fragilis*). *Fuligo septica*, on the contrary, requires a considerable time. A. L. S.

Mycetozoa from Poland.—HELENA KRZEMIENIEWSKA ("Ein Beitrag zur Biologie der Schimmelpilze," *Acta Soc. Bot. Pol.*, 1929, 6, 86-92. Polish with German summary). The author secured the growth of a considerable number of Mycetozoa by taking samples of soil from certain localities, and spreading over these sterilised rabbit dung; or sterilised hay was laid out, and over that fresh earth was scattered. The most frequent to develop were *Didymium difforme*, *D. nigripes*, *D. squamulosum* and *Perichæna corticalis* var. *liceoides*; they appeared in many different cultures. A list of those that were more rare and of those that appeared only once is given. It was also noted that the rate and manner of growth varied: in some few sporangia were formed, in others only plasmodia which passed over to sclerotia, this result evidently due to the culture conditions. It was also surmised that all species on the substratum were not detected, so that the list in no way indicates an exact account of the mycetozoa from a given district. A. L. S.

Study of Plasmodiophora.—A. S. HORNE ("Nuclear Division in the Plasmodiophorales," *Ann. Bot.*, 1930, 44, 199-231, 2 pls., 1 text-fig.). The writer has contributed an account of nuclear division and the general sequence of events in the Plasmodiophorales. For this he has studied not only *Plasmodiophora*, but also *Spongospora* and *Sorosphaera*. He divides his results into three phases: (1) Somatic phase: the nuclei divide by karyokinesis, they are haploid, and the chromosome number is four; the processes of division is described. (2) Transitional phase: the nuclei become achromatic, and it is assumed that there is a fusion—cœnocytic growth forms followed by the union in pairs of nuclei of opposite sex. (3) Meiotic phase: in this post-transitional phase the nuclei are diploid, four chromosomes are seen in the neighbourhood of each pole, at a further stage these assemble together: the heterotype spindle configurations show four chromosomes. These meiotic divisions are sometimes followed by a third mitosis which precedes spore-formation. An extensive list of literature on the subject is given. A. L. S.

TECHNICAL MICROSCOPY.

Simplified Apparatus for Ultra-violet Microscopy.—L. C. MARTIN and B. K. JOHNSON (*Journ. Sci. Instruments*, vol. 7, no. 1, Jan. 1930, 8 figs.). The purpose of this paper is to show how the ordinary types of microscope stands can be adapted to replace the Barnard-Beck microscope used in ultra-violet photomicrography. Three methods are described in which the fine adjustment of the microscope is dispensed with and focusing accomplished by means of elastic deformation of the stage.

In the first a scale-pan is hung on a thread connecting the upper end of the stage of the Barnard-Beck microscope and a wall behind it, and by applying suitable weights to the scale-pan the object can be moved through small intervals. A Watson "Service" microscope is used in the second method. Two mercury reservoirs, one fixed to the stage, the other independent of the microscope and adjustable, and a manometer are connected by rubber tubing. By raising or lowering the adjustable reservoir the height of the mercury in the fixed reservoir may be changed, thus causing a displacement of the stage.

Thirdly, elastic deformation of the stage is produced by a spring of horseshoe shape, the heels of which are rigidly attached to that part of the stage which is

nearest the limb. At the toe of the spring a micrometer screw which bears upon a steel ball, which, in turn, rests in a hole on the stage, is mounted so that, when the screw is rotated, the spring and the stage are pressed apart, thus producing slight deformation of the stage. The screw is actuated by a milled head carrying a divided drum head, the two being loosely coupled together, thus preventing disturbances due to the pressure of finger and thumb when actuating the screw directly. To justify these methods it is shown that the small tilt imparted to the object would not impair the image over different parts of the field.

In each case the movement of the stage is determined by an optical control method, and the hysteresis of the mechanism is given.

The methods are illustrated diagrammatically, and photographs taken by each method are published. J. S.

NOTICES OF NEW BOOKS.

The Planktonic Diatoms of Northern Seas.—By MARIE V. LEBOUR, D.Sc. 1930. ix, 244 pp., 4 plates, 181 text-figs. Published by the Ray Society; sold by Dulau & Co., Ltd., 32, Old Bond Street, London, W.1. Price 12s. 6d.

Oeuvres complètes de Christiaan Huygens.—Tome XVI. Percussion. Question de l'Existence et de la Perceptibilité du Mouvement Absolu Force Centrifuge. Travaux divers de Statique et de Dynamique de 1659 à 1666. 1929. 600 pp., 91 text-figs. Published by the Société hollandaise des Sciences, Haarlem, Holland.

The Microscopical Examination of Coal.—By C. A. SEYLER, assisted by W. J. EDWARDS. 1930. vi, 67 pp., 17 plates. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 2s. 6d. net.

The Use of the Microscope.—By JOHN BELLING. 1930. xi, 315 pp., 28 text-figs. Published by the McGraw Hill Publishing Co. Ltd., 6 & 8, Bouverie Street, London, E.C.4. Price 20s. net.

Medical Research Council.—A System of Bacteriology in Relation to Medicine. By VARIOUS AUTHORS. 1929. 9 vols. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price £8 8s. a set (post free £8 14s. 9d.).

Diet and the Teeth : an Experimental Study. Part I. Dental Structure in Dogs.—By MAY MELLANBY. Medical Research Council Special Report Series, No. 140, 308 pp., 109 plates, 55 text-figs. H.M. Stationery Office, London. Price 17s. 6d.

This report gathers together Mrs. Mellanby's exhaustive studies on the relation of diet to the structure of the teeth and jaws in dogs. The observations on the rôle of vitamin D in controlling the growth of the teeth grew out of the well-known work of Prof. E. Mellanby on the etiology of rickets. A detailed account is here given of the dentition, of the normal processes of development, eruption and shedding of the teeth in dogs, and of the variations in these processes dependent upon such factors as the size and breed of dog. The normal processes are compared with those occurring under various experimental conditions, and the differences in the structure of the teeth and related tissues arising under these conditions are also described and compared. A definite relationship is established between defectively calcified or hypoplastic teeth and rickets in dogs. The teeth, in fact, are a good index of

the calcification processes taking place at varying periods during development, for the tissues, once laid down, are not later reabsorbed, as is the case with the bones. The report contains a series of superb photomicrographs of the teeth. G. M. F.

The Immunology of Parasitic Infections.—By W. H. TALIAFERRO. 1929. xv, 414 pp., 28 text-figs. Published by the Century Co., New York and London. Price 25s. net.

Although the study of immunity in infections due to animal parasites is still in its infancy as compared with our knowledge of immunity in bacterial infections, there is a considerable amount of literature on the subject. Up to the present, however, no attempt has been made to bring together in one publication an account of all the work done. This task has been achieved by the author of the present volume. It is a work which, in the author's words, "is not in any sense intended to be a treatise on immunology, but a compilation and, as far as possible, an evaluation of the mass of immunological work that has been done on infections with animal parasites." The timely appearance of this work will be appreciated by readers of various interests. The medical immunologist will find in it ample material for the comparative study of immunity in infections of animal and bacterial origin, while to the zoological parasitologist it will serve both as an introduction to immunology in general and as a critical summary of the present state of our knowledge of immunity in parasitic infections.

The first chapter is devoted to introductory concepts of parasitism, infection and immunity reactions, and is very valuable to the parasitologist, who is often unfamiliar with immunological terminology. The second chapter describes the serological reactions used in diagnosis (complement fixation, agglutination, precipitin reactions, etc.). The methods are first discussed generally, and their application in various infections due to protozoa and metazoa are critically described. In Chapter III lysins and reproduction-inhibiting anti-bodies in trypanosomiasis and malaria are dealt with. Much of this is pioneer work done by the author himself and by his associates, and the phenomena described, as far as we know at present, are peculiar to protozoa. In Chapters IV and V an account is given of the protective and curative action of immune sera in protozoan and helminthic infections, and of hypersensitiveness and the cutaneous tests used to detect parasitic infections. Other parts of the book are devoted to the production of symptoms by parasites (Chapter VI), to the cellular basis of immunity as exemplified in parasitic infections (Chapter VII), to the nature and production of immunity in parasitic infections (Chapter VIII), and to serological and immunological reactions used in the classification of parasites (Chapter IX.).

The various subjects are considered fully and critically, every source of information being fully acknowledged. There are 75 pages of references, invaluable to anybody desiring to consult the original literature on the subject. A catalogue of the parasites considered in the present volume is appended. It gives their scientific names, their common synonyms and hosts. The usual indices of authors and subjects are given at the end of the book.

Although the author gives an exhaustive and up-to-date review of all the recent works on immunology in parasitic infections, one or two omissions have been noted. Thus, in discussing Rieckenberg's blood platelet test or the "adhesion phenomenon" the author omits to mention the works by Brown and Davis (1927), who have considerably simplified and improved the original method.

The author is to be congratulated on making a valuable contribution to the literature on immunology, which will be found indispensable to all workers in medical zoology.

C. A. H.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20, HANOVER SQUARE, LONDON, W.1, ON WEDNESDAY, MARCH 19TH, 1930, PROFESSOR R. RUGGLES GATES, M.A., PH.D., F.L.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected :—

As Ordinary Fellows of the Society :—

Miss Dagny Erikson, B.A., Richmond.
F. J. Fraser, M.Sc., Ottawa.
H. J. Harper-Roberts, Liverpool.
W. Faitoute Munn, B.S., West Orange.
J. A. Reddie, F.I.C., Bradford.

As Honorary Fellow :—

Professor E. B. Wilson, Columbia University.

The Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

As an Ordinary Fellow of the Society :—

Alfred Llewellyn Howden, Wakefield.

As Honorary Fellow :—

Professor Sir John Bretland Farmer, M.A., D.Sc., LL.D., F.R.S.,
London.

Donations were reported from :—

Mr. E. Heron-Allen, F.R.S., and Mr. Arthur Earland, F.R.M.S.—

Five Paratype Slides of *Miliammina* : a New Siliceous Genus of Foraminifera.

Rev. Dingley P. Fuge—
Three Slides of *Navicula alpestris*.

The Century Co.—

“The Immunology of Parasitic Infections.” By W. H. Taliaferro.

The Carnegie United Kingdom Trust—
Two hundred and fifty pounds.

Société hollandaise des Sciences de Haarlem—

“Oeuvres Complètes de Christiaan Huygens.—Tome XVI.”

Votes of thanks were accorded to the donors.

The Death was reported of :—

Thomas Castle. Elected 1927.

A vote of condolence with the relatives was passed.

Mr. Joseph E. Barnard, F.R.S., F.Inst.P., then delivered his postponed Presidential Address on

“Resolution and Visibility in Medical Microscopy.”

Mr. A. Chaston Chapman moved : “That the best thanks of this meeting be accorded to Mr. Joseph E. Barnard for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society.”

Mr. Conrad Beck seconded the proposal, which was carried by acclamation.

Mr. Barnard responded.

The President announced that the Biological Section would meet in the Library on Wednesday, April 2nd, 1930, at 7.30 p.m.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20, HANOVER SQUARE, LONDON, W.1, ON WEDNESDAY, APRIL 16TH, 1930, PROFESSOR R. RUGGLES GATES, M.A., PH.D., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected :—

As an Ordinary Fellow of the Society :—

Alfred Llewellyn Howden, Wakefield.

As Honorary Fellow :—

Professor Sir John Bretland Farmer, M.A., D.Sc., LL.D., F.R.S.,
London.

Nomination Certificates in favour of the following candidates were read for the first time, and directed to be suspended in the Rooms of the Society in the usual manner :—

William Neale Ellis, M.P.S., Appledore.
Syed Hedayetullah, M.Sc., Tufnell Park.
Carl Adolphe Klein, Enfield.
Wilfred Mather, F.I.C., Manchester.
Ivor Vickery Newman, M.Sc., Highgate.
James Williamson, M.P.S., Richmond.

The Deaths were reported of :—

Thomas Stewart Adair. Elected 1893.
John Macintyre. „ 1894.
Ernest A. Pinchin. „ 1911.

Votes of condolence with the relatives were passed.

Donations were reported from :—

Mr. H. S. Jennings—

“ Genetics of the Protozoa.” By H. S. Jennings.

Department of Scientific and Industrial Research—

“ The Microscopical Examination of Coal.” By Seyler & Edwards.

Professor A. Gandolfi Hornyold, F.R.M.S.—

A Zeiss Microscope in case.

Professor S. R. Kashyap—

“ Liverworts of the Western Himalayas and the Panjab Plain.” By
S. R. Kashyap.

Votes of thanks were accorded to the donors.

The Treasurer presented the Financial Report and Balance Sheet for the year 1929.

FINANCIAL REPORT FOR THE YEAR ENDING 31st DECEMBER, 1929.

It is always a pleasure to report that the Society, existing as it does for the encouragement and advancement of scientific knowledge, can show at the close of its financial year a balance of income over expenditure. This balance is in no

small measure due to the efficient and economical reorganisation of the Society's office, which has attained a high standard of conduct on very limited resources.

The balance, £14 2s. 2d., has been carried to the reduction of the accumulated debit balance of £102 3s. 9d. brought forward, thus reducing this to £88 1s. 7d.

There is no change in the Life Membership Account, which stands at £1,884 10s. The Investment Account remains the same at £1,969 10s. 5d., the market value of the investments at 31st December, 1929, being £2,124 15s. 2d., showing a slight depreciation on the previous year's figure. The sum of £100 has been received during the year by bequest from the late Mr. A. N. Disney, and placed to Capital Account, which now stands at £2,352 2s.

With regard to the Loan Account £400, the Auditors recommend that £100 of this be repaid out of the income from sales of "The Microscope and Catalogue of Instruments," which now totals £174 17s. 8d.

The £245 13s. 10d. which is the aggregate of the expenditure on the Library during the year, has been carried to Suspense Account, which, through the good offices of the Librarian, it is hoped to balance by a grant.

Much of the office furniture and equipment is sadly in need of replacement, and this has been written down by £49 16s. 8d. It should be observed, however, that no provision has been made for dilapidations accruing under the Society's expiring lease of its present premises.

Turning to the Income and Expenditure Account, £97 has been spent on Library binding, and this amount has been transferred to the Grant Suspense Account already referred to. Considerable economy has been effected in the cost of distribution of the Society's Journal, as a result of this work being undertaken from the Society's office, while the sales at £551 show a further increase of approximately £40, and a grant of £100 has been received from the Royal Society. Thus, despite the fact that the production costs amount to over £930, the net figure is reduced to £181 as against £309 in the previous year.

On the assets side the Admission Fees at £58 16s. is slightly less than in the previous year, but the income from Subscriptions has been increased by about £40.

It is a matter of regret that our Society, with its long and honoured traditions, has no adequate funds, either by donation or bequest, from which to award grants in aid of original or specific research, though the increasing importance of theoretical and applied microscopy, both in science and in industry, is abundantly acknowledged, and I venture to bring the claims of the Society in this respect to the notice of Fellows and others to whom appreciation of its work and the advancement of specific knowledge is of special appeal.

The number of Fellows on the Roll of the Society at 31st December, 1929, is as follows :—

Number of Fellows on the Roll at 31st December, 1928		513
Fellows elected or reinstated during the year	32	
Fellows written off in 1928, reinstated 1929	6	38
	—	—
		551
Resigned or removed during the year	14	
Resigned 1929 and written off 1928	26	
Deceased during the year	7	
	—	47
		—
		504

The total is made up of :—

(a) Ordinary Fellows	460
of whom 426 have paid their sub-	
scriptions	
27 are in arrear	
—	
453	
7 are two years in arrear	
—	
460	
—	
(b) Life Fellows	29
(c) Honorary Fellows	14
Add : Elected during year . . .	3
	—
	17
Less : Deceased during year . . .	2
	—
	15
	—
	504
	==

For Balance Sheet *see* pp. 292, 293.

On the motion of Mr. C. F. Hill, seconded by Dr. J. A. Murray, the Report and Accounts were unanimously approved and adopted.

The President moved the following resolution from the Chair, which was carried unanimously :—

“ That the appreciation and thanks of the Fellows be conveyed to Messrs. Thomson McLintock & Co., Chartered Accountants, for their generous services as Honorary Auditors to the Society during the past year.”

Exhibits.—An inexpensive student’s microscope was exhibited and described by Mr. Charles Perry.

Dr. J. A. Murray exhibited and described some stained preparations of *Pleurosigma* and of neurofibrillæ, inviting Mr. C. Beck to examine the former and make further observations thereon at a subsequent meeting.

Papers.—The following communications were read and discussed :—

Mr. A. Craig-Bennett—

“ An Embedding Apparatus for Research Workers.”
(Read by Dr. Tierney.)

Mr. John Smiles, A.R.C.S., F.R.M.S.—

“ The Measurement of Spherical Aberration in High Numerical Aperture Objectives by Interferometry.”

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. C. Perry and Dr. J. A. Murray for their exhibits.

INCOME AND EXPENDITURE ACCOUNT

Dec. 31, 1928.								
£	s.	d.				£	s.	d.
183	6	9	To Rent, Lighting, Heating and Insurance .					
366	1	5	„ Salaries and Reporting, etc.					
			„ Sundry Expenses—					
			Library Books and Binding		97	17	0	
			Less: Transferred to Grant Suspense Account		97	17	0	
			Stationery, Printing, Postages and					
			Sundry Expenses		167	15	1	
			Repairs and Renewals		3	18	10	
162	0	4	Refreshments at Meetings		7	3	7	
			„ Journal, etc.—					178 17 6
			Expenditure—					
			Printing		704	12	1	
			Editing and Abstracting		82	1	9	
			Illustrating		70	16	10	
			Postages and Addressing		74	12	4	
			Less Receipts—					
			Grant from Royal Society	£	s.	d.		
			100	0	0	932	3	0
			Sales	551	19	8		
309	4	7	Advertisements	98	3	10		
						750	3	6
								181 19 6
			„ Depreciation of Furniture					49 16 8
2	1	4	„ Balance, being Excess of Income over Ex-					
			penditure					14 2 2
£1022	14	5						£1057 17 7

Dr.

BALANCE SHEET AS AT

		LIABILITIES.		£	s.	d.	£	s.	d.
I. Capital—									
Being (a) Life Compounded Subscriptions received		from 1st January, 1877, to 31st							
		December, 1929		1884	10	0			
(b) Quekett Memorial Fund				100	0	0			
(c) Mortimer Bequest				45	0	0			
(d) A. N. Disney Bequest				100	0	0			
(e) Amounts received in respect of Sales of		Books from the Library (surplus to the							
		Society's requirements)		222	12	0			
							2352	2	0
II. Loan Account							400	0	0
Note.—The Hon. Treasurer of the Society has advanced		this sum to meet the cost of publishing “The							
		Microscope and Catalogue of Instruments.”							
		The loan is made to the Society free of interest.							
III. Sundry Creditors—									
Subscriptions paid in advance				38	16	6			
Journal Subscriptions paid in advance				120	15	10			
On account of Journal Printing, etc.				557	4	3			
							716	16	7

£3468 18 7

London, 13th March, 1930. We have examined the Books and Accounts of the Royal Microscopical Society for the year to 31st December, 1929, and have found the transactions correctly recorded and sufficiently vouched.

In our opinion the foregoing Balance Sheet is properly drawn up so as to exhibit
CYRIL F. HILL, Hon. Treasurer.

FOR YEAR TO 31st DECEMBER, 1929.

Cr.

Dec. 31, 1928.

£	s.	d.		£	s.	d.	£	s.	d.
842	6	1	By Subscriptions	832	9	2			
			„ Subscriptions for 1929 unpaid	48	7	9			
							880	16	11
			„ Donations				12	17	0
73	10	0	„ Admission Fees				58	16	0
2	17	6	„ Sundry Sales				0	15	0
104	0	10	„ Interest on Investments and Deposit Account				104	12	8

£1022 14 5

£1057 17 7

31st DECEMBER, 1929.

Cr.

ASSETS.			£	s.	d.	£	s.	d.
I. Furniture, Instruments, etc., as at 31st December, 1928 .			251	5	8			
Additions during year			4	11	0			
						255	16	8
Less : Sales during year				6	0			
Depreciation charged for year			49	16	8			
						55	16	8
							200	0
							1969	10
II. Investments								
£400 London & North Eastern Railway Co. 3% Debenture Stock.								
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.								
£915 11s. 4d. India 3% Debenture Stock.								
£150 Metropolitan Water Board "B" Stock.								
£612 London Midland & Scottish Railway Co. 4% Preference Stock.								
£200 New South Wales 5½% Loan 1947-57.								
£421 1s. 5% War Loan, 1929-47.								
Note.—The Market Valuation of the above Investments at 31st December, 1929, was £2,124 15s. 2d.								
III. "The Microscope and Catalogue of Instruments"—								
Amounts expended on publication to date, less sales in previous years			359	10	8			
Less Sales for 1929			65	15	5			
Note.—The Hon. Treasurer of the Society has given his personal guarantee to meet any part of this expenditure that is not recovered by means of sales of the publication.						293	15	3
IV. Stock of Library Catalogues, at cost			147	16	10			
Less : Transferred to Grant Suspense Account			147	16	10			
V. Sundry Debtors—								
Grant Suspense Account			245	13	10			
Subscriptions Unpaid, amounts due in respect of Journal Sales, Advertisements, etc.			268	4	0			
						513	17	10
VI. Cash—At Bank—on Current Account			253	11	11			
At Bank—on Deposit Account			150	0	0			
In hand			0	1	7			
VII. Income and Expenditure Account—						403	13	6
As at 31st December, 1928			102	3	9			
Less : Excess of Income over Expenditure for the year ended 31st December, 1929			14	2	2			
						88	1	7
						£3468	18	7

a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library and Stock of Journals (valued for insurance, together with the Furniture, Instruments, etc., at £4,600).

(Signed) THOMSON McLINTOCK & CO.,

71, Queen Street, E.C. 4.

Chartered Accountants, Hon. Auditors.

The President made the following announcements :—

The Biological Section will meet in the Library on Wednesday, 7th May, 1930, at 7.30 p.m.

The next Ordinary Meeting of the Society will be a meeting for the consideration and discussion of recent advances in current research and practice in microscopic metallography. A comprehensive exhibition will be held in connection with the meeting, which will take place on May 21st in the Great Hall at King's College, London.

The Fifth International Botanical Congress will be held at Cambridge on August 16–23, 1930, under the Presidency of Professor A. C. Seward, F.R.S. Full particulars can be obtained from the Hon. Secretaries: Mr. F. T. Brooks, Botany School, Cambridge, and Dr. T. F. Chipp, Royal Botanic Gardens, Kew.

The business proceedings then terminated.

A SPECIAL GENERAL MEETING

OF FELLOWS WAS HELD AT 20, HANOVER SQUARE, LONDON, W.1, ON WEDNESDAY, MAY 14TH, 1930, PROFESSOR R. RUGGLES GATES, M.A., PH.D., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

William Neale Ellis, M.P.S., Appledore.
 Syed Hedayetullah, M.Sc., Tufnell Park.
 Carl Adolphe Klein, Enfield.
 Wilfred Mather, F.I.C., Manchester.
 Ivor Vickery Newman, M.Sc., Highgate.
 James Williamson, M.P.S., Richmond.

The Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

Lionel Percy Clark, London.
 John Massey Preston, B.Sc., Chorley.

The Death was reported of :—

Edmond Warner. Elected 1885.

A vote of condolence with the relatives was passed.

Donations were reported from :—

Mr. L. P. Clarke—

Lucernal Projection Microscope by Apps.

Mrs. E. T. Newton—

117 Micro Slides from the Collection of the late Mr. E. T. Newton, F.R.S.

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—
Collection of Slides of Freshwater Rhizopoda.

Mr. C. D. Soar, F.R.M.S.—

Collection of Publications on the Hydracarina. (Various authors.)

Votes of thanks were accorded to the donors.

The President then called upon the Secretary to read By-Laws 85 and 87 and the notice convening the Special Meeting.

The President announced that the Special Meeting had been called to receive a report from the Council in regard to new premises, and called upon Dr. Tierney to make a statement thereon.

Dr. Tierney drew attention to the last Annual Report, in which the Council reminded Fellows that by the effluxion of time the Society's present lease of premises at 20, Hanover Square, expired very shortly. An endeavour had been made to renew this, but without success, and the Council was perforce obliged to seek new premises elsewhere. He referred to the difficulties of the task, and to the opprobrious inadequacy of housing accommodation for scientific societies in London, which play no inconsiderable part in our national life in the advancement of scientific and applied knowledge. The present effective area, he pointed out, is very prescribed, but he observed that the centre of that area showed signs of definitely shifting, in the direction of Bloomsbury, to the vicinity of the British Museum, and he was happy to report that, as a result of successful negotiations, eminently suitable premises for the Society's activities had been secured in the British Medical Association's House in Tavistock Square, London, W.C.1, and that a lease had been granted which would ensure to the Society security of tenure for a number of years, with excellent accommodation for its meetings, and the more adequate housing of its library and historical collections, in addition to the Society's offices, and he ventured to think that in our new surroundings the aims and objects of the Society in the advancement of microscopy, both in science and in industry, would not only be well maintained, but definitely advanced.

Dr. Tierney's statement was received with applause, and, in reply to Mr. Blood, he said that the library would be available to Fellows as hitherto through the Librarian.

The proposal was approved.

The following papers were read in title :—

Mr. E. G. Miller, F.R.M.S.—

“ Frozen Section Technique.”

Mr. Richard Palmer, B.Sc.—

“ A Simple Method for Estimating ‘ Osmic Acid,’ with some Applications to Cytological Technique.”

Announcements.—The President made the following announcements :—

A Special Meeting of the Society will be held in the Great Hall, King's College, Strand, London, W.C.2, on Wednesday, 21st May, 1930, from 3 to 10 p.m. Professor C. H. Desch, D.Sc., Ph.D., F.R.S., will preside. 3 p.m., an Exhibition and Demonstration of the latest types of Metallurgical Instruments and Apparatus will be opened ; 7 p.m., Professor Nils E. Svedelius (Upsala) will deliver a communication on “ The So-called Freshwater Lithoderma ” ; 7.45 p.m., Scientific Communications and Discussion on Recent Advances in Current Research and Practice in Microscopic Metallography.

The next Ordinary Meeting of the Society will be held on Wednesday, October 15th, 1930.

The next Meeting of the Biological Section will be held on Wednesday, November 5th, 1930.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 18th to September 13th, 1930.

The proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
SEPTEMBER, 1930.

TRANSACTIONS OF THE SOCIETY.

XIII.—EARLY ACHROMATIC MICROSCOPES BY JAMES SMITH.

By REGINALD S. CLAY and THOMAS H. COURT.

(Read February 19, 1930.)

ONE PLATE.

It is well known that, in common with the founders of the firms of Ross and Powell, Smith of "Smith and Beck" also made microscopes for the trade. Among others, Smith worked for Tulley, Dixey, Dollond, Carpenter and Westley, Bates, Pritchard, and, as we shall see, for Elliott.

In a letter* sent to the late Sir Frank Crisp by Joseph Beck, dated April 15, 1885, Beck says: "I send you overleaf historical notes concerning Inst. I wish you to add to your Collection. I think it is interesting as an intermediate form. . . ."

The notes are of sufficient interest to be reproduced in full.

"Joseph Jackson Lister had for several years been working on the microscope object-glass; full description of his work appeared in the Transactions of the Royal Society. He had been using an instrument constructed by Mr. Pritchard, and, finding the stand very far from what he thought desirable, he called on Mr. Bates, Optician in the Poultry, and asked him if he could recommend to him a good worker in brass. He sent him to James Smith, Ironmonger Row, St. Luke's, who was making instruments on Pritchard's model for the trade. Under J. J. Lister's supervision, and from designs of his own, he constructed three stands which, when finished, James Smith being afraid he might interfere with his trade connection if he

* These are all in the Court Collection.

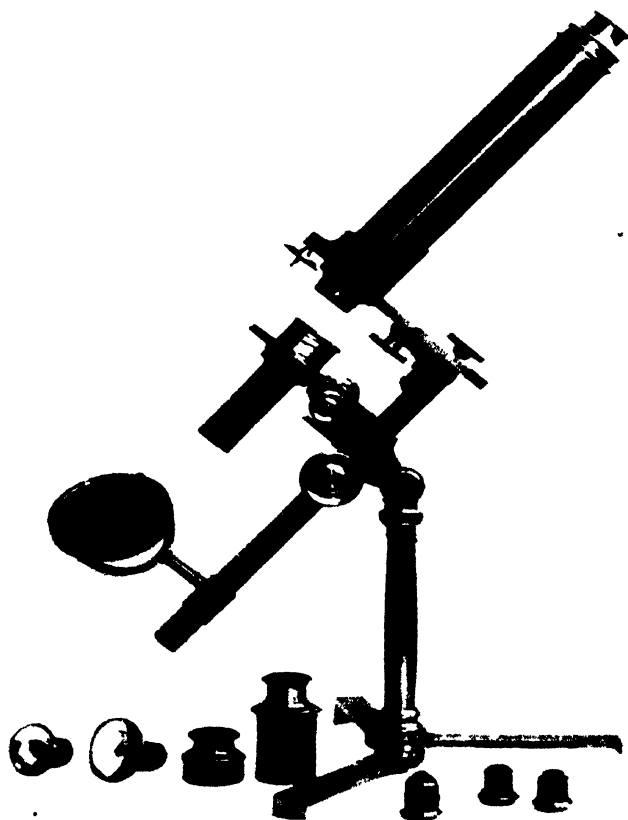
sold them privately, he (*presumably Lister*) advised him, as he did not wish to interfere with the trade, to take them round to his customers and offer them for sale. Thus advised, he took them to Bates, Dixey, and Dollond. On looking at them, all these opticians refused to purchase them, saying they would not suit their customers, and he came back sadly disappointed. J. J. Lister then told him he must sell them privately, and he would see what he could do for him. The first was purchased by Richard Low Beck, his (*Lister's*) partner in the wine trade—the present one—and was delivered in 1839. Another was bought by Mr. Alexander of Ipswich, and the third was probably, but of this there is no documentary evidence, purchased by J. J. Lister himself. From this time James Smith started as a maker of microscopes, and J. J. Lister taught him how to grind the glasses, those supplied with the instrument having been designed, if not actually worked, by J. J. Lister. That was the foundation of the firm of which the present representatives are R. and J. Beck."

Beck seems to have made a mistake in his statement that Lister had been using a microscope by Pritchard. According to Nelson (*J. Roy. Micr. Soc.*, 1900, p. 550), Lister bought a microscope from Tulley on May 20, 1826, which had been made for Tulley by James Smith. This is confirmed by entries in J. J. Lister's account books,* which show payments "on account" to James Smith, at about this time, "for brasswork for the microscope he is making" and a final payment to Tulley. The same books also show that he had bought a large microscope from Bates some time before this, to which he had had alterations made. This was, of course, a non-achromatic instrument. The accounts show further that Lister did, in fact, as supposed by Beck, buy the third microscope from Smith, "without object-glasses," on October 26, 1840, for £28 19s. This instrument is now in the Wellcome Medical Museum, having been lent by the Royal Society of Medicine.

The following extracts from the accounts illustrate the practical interest which J. J. Lister took in the optical trade; also that it was partly due to his assistance that James Smith was given his first start in business. It will be noticed that Smith repaid him partly by work done, and the balance in cash in 1842.

<i>Dr.</i>					<i>Cr.</i>			
James Smith, 50, Ironmonger Row.				1840		£	s.	d.
To L(ister) B(eck) and B(eck)				4	By expenses Knight,			
1839					repairing instru-			
12 month 21	„	Loan for tools	5 0 0		ment ...	1	0	0
1840				1841	„ Rest for Micro-			
1 month 6	„	do.	... 11 0 0		scope 3/6,			
1 „ 18	„	do.	... 5 0 0		Obj. 19/., Dia-			
12 „ 21	„	do.	... 18 0 0		mond pencil 15.6			
				1842	„ Pocket lens 8/6			
					„ A12 pull-out			
					telescope 28/-			
				5	„ Sundry Jobs	£10	13	14
				6 25	„ L.B.B. Bal ^c.	...	24	15
							6	6
£39 0 0						£39 0 0		

* These are all in the Court Collection.



Achromatic Microscope constructed by James Smith, c. 1839.

Other entries are :

1840			£	s.	d.
2 m.	25	To engraving for Microscope, J. W. Lowry ...	3	7	6
3 m.	4	„ Presented to J. Smith printed description of Microscope, Couchman	2	6	0

The first of the three microscopes, which Joseph Beck tells us was bought by R. L. Beck and given by himself to Crisp, is now in the Science Museum at South Kensington.* It has been figured and described by E. M. Nelson in the *Journal of the Society* (1900, pp. 550–8, fig. 147) ; we need not dwell upon it, therefore, here. This microscope is referred to as “ Smith and Beck’s Microscope ” both by Mayall (Cantor Lectures, *Journal Society of Arts*, 1888, p. 1168) and by Carpenter (“ The Microscope and its Revelations,” 1891, p. 153), but, as we shall see from the pamphlets mentioned below, it was made before Smith was joined by Beck.

The second of these three microscopes, sold to Alexander of Ipswich, has not so far been identified. It would be very interesting to see how it differed from the other two, for presumably Smith introduced into these microscopes as many modifications as possible, to ascertain which would best please his customers.

The third, in the Wellcome Museum, differs from the one Mr. Nelson described in several particulars.

1. It has a fine adjustment, consisting of a tube sliding inside the coarse adjustment tube which the rack actuates ; this inner tube is moved by a screw with a divided head, working against the action of a spring. The body tube is consequently attached to this inner tube instead of to the intermediate tube.
2. The axes of the pinions of the mechanical stage with which the microscope is furnished are both in the plane of the stage : one projects to the right, and produces the front-back movement ; the other projects backwards on the right of the stand, and controls the sideways motion of the stage. Both of the heads are graduated.
3. The substage consists of a ring carried at the end of an arm, which can be swung out of the optic axis, as in the Tulley : it can also be moved up and down on the limb carrying the mirror. A wheel diaphragm is mounted above the ring. No doubt a fitting carrying a condensing lens could be pushed up into the ring from below.

An old microscope has come into our hands which at first sight appeared to be an ordinary non-achromatic variation of the Jones “ Most Improved ” microscope, but on closer examination it proved to be an early achromatic

* These are all in the Court Collection.

one which can be definitely ascribed to James Smith. It is inscribed "W. Elliott, 268, High Holborn."

Although developed from the "Most Improved"—having that microscope's folding stand and its stage sliding on a square limb, and focusing by the aid of a sunken rack—it lacks the "aquatic" motion, and has, instead, a fixed transverse arm, similar to that afterwards adopted by Ross. It is also solely a compound microscope.

The cypepiece of this microscope is of the form which Smith had been constructing for Tulley, but it slides into the body tube instead of being screwed to it, as is the Tulley.

It has the fine adjustment so largely used for many years by Ross and other makers, consisting of a screw on the nose of the body tube, which raises the objective by the aid of a lever. This is the fine adjustment in the first of Smith's three microscopes described by Nelson. It was also used by Smith in the microscopes which he made afterwards commercially, and which he describes in the pamphlets mentioned below.

The Elliott microscope has a Wollaston substage condenser, i.e., a tube containing a convex lens with a diaphragm adjustable at or near the focus of the lens.

But by far the most important feature of this microscope, and the one which has led us to bring it before the notice of this Society, is the type of objective with which it is furnished. It has compound achromatic lenses exactly like those described in a rare pamphlet entitled "Description of the Improved Achromatic Microscope made by James Smith." The pamphlet is dated 1840, and was supplied with the microscope.* After describing the microscope, he goes on to say :

"The Achromatic Object-glasses provided are all or any of the following powers, viz.—

1. A Glass of $\frac{7}{10}$ inch in focal length : it is to have the cap, *a*, slid over it when used alone.
2. To slide upon No. 1, the notch in its tube fitting on the pin in No. 1. They make together a glass of $\frac{9}{10}$ inch in virtual focus.
3. To slide in like manner on No. 1, & with it equivalent to a glass of $\frac{6}{10}$ inch focus.
4. A Compound glass of $\frac{7}{10}$ inch focus.
5. Sliding on No. 4, & making a combination of $\frac{1}{4}$ inch focus.

Observe that No. 4 has a movable outer tube, which should be drawn out till stopped by the screw, *b*, when this power is used alone, but must be pushed home when No. 5 is slid on in front to raise the power to $\frac{1}{4}$ inch.

The three Lieberkuhns, O, O', O'', adopted to Nos. 2, 3, 4, are applied by sliding them in front of each respectively."

* These are all in the Court Collection.

This Elliott microscope has the powers 1, 2, 3, exactly as described in this pamphlet, and is therefore undoubtedly by Smith, and was probably made about 1839 or 1840.

The powers described in a second pamphlet by Smith, of the same date and title,* differ slightly from these, for the two higher powers were supplied with an adjustable correction collar.

According to the entry in Lister's account book above quoted, the plates illustrating these pamphlets were engraved by J. Wilson Lowry in February, 1840. Lowry was a relation of Cornelius Varley, one of the original members of this Society.

An examination of the Tulley-Lister microscope which was given to the Wellcome Museum by the executors of the late Lord Lister, strongly suggests that the nosepiece fine adjustment which it has was added to it by Smith at about this time, for it is almost identical with the peculiar form, with the springs in tubes, embodied by Smith in the first of the three microscopes referred to in J. Beck's letter.

* These are all in the Court Collection.

XIV.—FROZEN SECTION TECHNIQUE.

By E. G. MILLER, F.R.M.S.

(From the Laboratory of the Imperial Cancer Research Fund, London.)

(Read May 14, 1930.)

ONE TEXT-FIGURE.

DURING the last few years certain difficulties in the preparation and staining of frozen sections have been encountered and overcome by slight modifications of accepted routine methods, which it is thought desirable to place on record.

Frozen sections have great advantages over the paraffin embedding method for rapid diagnosis, the study of various chemical constituents, which are soluble in alcohol or paraffin solvents, the examination of vitally stained tissues, and for preparations of the skin and teeth.

Any of the well-known fixatives may be used except those containing osmic acid, as osmic material is very apt to crumble on cutting. For rapid diagnosis the best fixative is 40 p.c. formaldehyde. Material is placed in this solution until it sinks below the surface, or in the case of fats, etc. (which do not sink), twenty minutes. It is then washed by transferring to a petri dish, filled with tap water a few minutes, and sections cut on the carbon dioxide microtome.

The material and sections may then be kept indefinitely in a solution of 10 p.c. formol saline (F.S.). This method applies to material containing fats and lipoids, but not for material vitally stained.

Cutting Frozen Sections.—The freezing agent used is carbon dioxide gas. The 40 cu. foot cylinder is inverted in an iron stand and connected by a flexible metal tube to the microtome; sufficient water is placed on the microtome table, and the block of material placed in position and carefully orientated so as to cut the section in the plane required. It is then frozen and the section cut. If the block is frozen too hard, the sections are very brittle and easily break into pieces; if, on the other hand, it is too soft, the sections have a torn and frayed surface. There is a temperature between these two extremes when the best sections are made, which can only be judged by experience. With reasonable care in these respects, no appreciable advantage attaches to the use of gum and sugar or dextrine solution for freezing, if the carbon dioxide apparatus is available.

The sections, when cut, adhere to the knife, and are removed by a camel-hair brush or the tip of the little finger of the left hand, and allowed to float off by dipping the finger or brush into a petri dish filled with tap or distilled water. Very delicate sections can best be observed if the petri dish is painted dead black on the outside. The sections are now ready for mounting, or they may be transferred to formol saline solution until required.

Preparing Gelatine Slides for Mounting Frozen Sections.—Two grammes of "Gold Medal" sheet gelatine are cut into small pieces, placed in a flask, covered with distilled water and left to soak for at least one hour. The fluid is made up to 100 cc. with distilled water, shaken, and allowed to become quite liquid at 60° C. There should be no need to filter.

A little of the melted gelatine is poured into a watch-glass, and the end of a 3 inch \times 1 inch clean slide is dipped into it. Films are made on clean slides by drawing the end of the dipped slide along the surface of the clean slides, as when making blood films. The slides are stood up on end, face to the leaning surface (to avoid dust), to dry. This takes about 15 minutes. When dry, they are ready for use, and may conveniently be kept in a slide tray, gelatine surface downwards. To tell which is the gelatine surface when dry, the slide is breathed on. The gelatine surface remains clear, whereas the glass surface becomes frosted. The 2 p.c. gelatine solution can be preserved by adding a crystal of thymol or kept in an ice safe. It is much better to make a little fresh when required. The gelatine film may retain the stain in the finished preparation because the gelatine is too strong. To obtain clean preparations make thin films and use as dilute a gelatine as possible, not more than 2 p.c.

Mounting Frozen Sections.—A glass rod is drawn out and bent at an angle of 130°, cut not less than an inch from the bend, and the cut end rounded in the flame. A petri dish is filled with distilled water. The best section from the petri dish containing the sections is selected, and the short limb of the glass rod passed under the section to pick it up. A gelatine slide is now taken in the left hand, plunged into the petri dish of distilled water, holding it just below and parallel to the surface. Holding the glass rod in the right hand with the section attached, plunge it into the water and allow the section to float on the surface of the water above the submerged slide, and gently raise the slide out of the water. If successfully performed, the section should be caught on the slide. Free the glass rod and place it immediately behind the section flat on the glass slide; tilt the slide until all the superfluous water is drained off—the section will be held in position by surface tension (text-fig. 1). By this method the section will be perfectly flat and free from wrinkles. The slide is now placed upon a flat surface, and a cigarette paper (a roll of toilet paper cut into three answers equally well) is wetted on both sides and lowered very carefully on to the section. Now take a piece of sheet filter paper folded several times, so as to make a thick pad about two inches wide and several folds thick, place this on the cigarette paper or toilet paper and, holding the free end of the pad with the left hand,

gently press four or five times with the palm of the right hand, rubbing one way only. Remove the pad and pull the cigarette paper away.

It frequently happens, owing to the mucilage and fat present in some material, that the section will adhere to the cigarette paper and not remain on the slide. This can be easily remedied, however, by wetting the cigarette or toilet paper with a few drops of pyridine in 50 p.c. alcohol. By this means the section will remain quite safely on the slide.

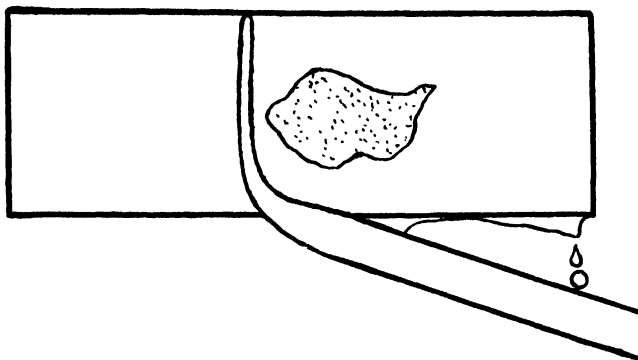


FIG. 1.

The slide is now placed in a corked specimen tube (4 inches \times 1 $\frac{1}{4}$ inch) or staining jar, containing at the bottom of the tube a plug of cotton-wool soaked in 40 p.c. formaldehyde and placed on a warm plate at about 50° C. The formalin vapour given off hardens the gelatine. After 15 to 30 seconds transfer to 10 p.c. formol saline, where the slide may remain indefinitely until required.

Staining Frozen Sections.—Frozen sections are much more difficult to stain than paraffin sections, chiefly on account of their thickness and their readiness to absorb any stain strongly. In addition, the natural fatty substances of the material have not been removed as a consequence of the drastic treatment necessary for paraffin embedding. Sections must not be allowed to dry during any part of the operation, and always before and after tap water rinse in distilled water.

Stains are best kept in 50 cc. dropping bottles. They are easy to use, clean, and economical. When staining frozen sections, it is as well to remember that generally the time allowed for staining paraffin sections may be reduced to one-fifth.

Staining Frozen Sections for Rapid Diagnosis. (Also good for mitosis and mitochondria).—(1) Stain Hollande (*see below*) one minute; (2) Rinse 30 p.c. alcohol; (3) Distilled water (rapid); (4) Decolourize in 3.5 p.c. iron alum (section goes black), control under microscope; (5) Wash distilled water; (6) Dip in 5 p.c. pyridine in distilled water; (7) Distilled water; (8) Wash running tap water at least 10 minutes; (9) Distilled water; (10) Dehydrate and mount Canada balsam.

Preparation of Hollande-chloro-carmin-iron alum (C.R. Soc. Biol., 1916, lxxix, p. 662).—Place 14 grammes carmine (powdered) in an evaporating basin; add 5 cc. pure hydrochloric acid little by little, stirring continuously until a compact homogeneous mass is obtained; leave in contact 24 hours; add 250 cc. distilled water; boil for half an hour; filter, make up to 200 cc. with 75 p.c. alcohol.

Staining Frozen Sections with Hæmatoxylin-eosin.—Eosin is usually employed as a contrast stain to hæmatoxylin, but not always with success. This is due to the ease with which eosin overstains, after which a proper differentiation is a long and tedious process even with paraffin sections. With frozen sections it is better to avoid overstaining by using a rather dilute eosin solution.

(1) Stain Ehrlich's hæmatoxylin 2 to 3 minutes; (2) Differentiate in 70 p.c. acid alcohol (0.5 p.c. hydrochloric acid); (3) Distilled water; (4) Blue hæmatoxylin by dipping in 5 p.c. pyridine in distilled water; (5) Wash in running tap water 10 minutes; (6) Stain eosin (0.2 p.c.) watery solution 5 minutes; (7) Wash in distilled water and leave in running tap water 10 minutes, control under microscope; (8) Rinse distilled water; (9) Rinse 50 p.c. to 70 p.c. to 90 p.c. alcohols, leave in 90 p.c. alcohol 3 to 5 minutes; (10) Finish dehydration and mount Canada balsam.

Staining Frozen Sections for Fat.—(1) Hansen's hæmatoxylin 1 minute, or Hollande method; (2) Wash distilled water; (3) Dip in 5 p.c. pyridine in distilled water; (4) Wash running tap water 10 minutes; (5) Rinse 50 p.c. alcohol; (6) Sudan III 15 minutes (*see below*); (7) Rinse 50 p.c. alcohol; (8) Distilled water; (9) Blow off water and mount in glycerine jelly.

Preparation of Sudan III.—(1) Make a saturated solution of Sudan III in absolute alcohol; (2) Filter; (3) Add twice its bulk of 50 p.c. alcohol; (4) Stand aside one hour. The solution is now ready for use.

A very convenient way to keep glycerine jelly is to put it into a small collapsible metal tube with screw top (obtainable from G. T. Gurr). When required, place the tube inverted in a small beaker containing hot water. When the gelatine is liquid, remove the screw top, squeeze a little on to the section, place in position cover-glass, warm on hot plate, and gently press to remove air bubbles, and clean up edges.

Staining Frozen Sections after Vital Staining with Acid Dyes.—Trypan blue and lithia carmine are two of the most frequently used dyes for vital staining. If this material is subjected to the paraffin embedding method, a great deal of the vital stain may be dissolved out during dehydration. This loss is easily overcome by fixing as for the rapid diagnosis method, and counterstaining as below:—

After Trypan Blue Vital Staining.—(1) Stain neutral red 30 seconds (*see below*); (2) Distilled water rapidly; (3) Absolute alcohol—using dropping bottle—rapidly; (4) Clear in xylol and mount Canada balsam.

After Carmine Vital Staining.—(1) Stain Harris hæmatoxylin 5 seconds; (2) Dip in 5 p.c. pyridine in distilled water; (3) Wash distilled water; (4) Dehydrate and mount Canada balsam.

Preparation of the Neutral Red Stain.—Neutral red, 1 gramme ; distilled water, 500 cc.; acetic acid (glacial), 3 cc.

Preparation of Harris Hæmatoxylin (Romeis B (1928), Taschenbuch der Mikroskopischen Technik 12 Auflage, p. 521, R. Oldenbourg, München-Berlin).—(A) 1 gramme hæmatoxylin in 10 cc. absolute alcohol. (B) 20 grammes potassium alum in 200 cc. distilled water dissolved by heat. After 24 hours, mix A and B, and add 0.5 red or yellow oxide of mercury. Boil, cool rapidly ; after 24 hours, filter. The dark red stain can be used immediately.

Staining Frozen Sections for Tubercle Bacilli.—This is best done with loose sections. (1) Stain in watch-glass 5 minutes carbol fuchsin at 50° C. ; (2) Decolourize 25 p.c. sulphuric acid ; (3) Wash thoroughly ; (4) Mount section on prepared gelatine slide in formaline vapour tube 10 seconds ; (5) Dehydrate and mount Canada balsam.

My very grateful thanks are due to Dr. J. A. Murray, F.R.S., Director, Imperial Cancer Research Fund, and to Dr. R. J. Ludford, for much help and encouragement.

XV.—THE MEASUREMENT OF SPHERICAL ABERRATION IN HIGH NUMERICAL APERTURE OBJECTIVES BY INTERFEROMETRY.

By J. SMILES, F.R.M.S.

(Read April 16, 1930.)

FIVE TEXT-FIGURES.

THREE years ago Beck described a simple method of determining the position of the foci of different zones of low-power microscope object-glasses, but admitted that, when perceptible aberrations were present, it was extremely difficult to interpret their nature. He tentatively stated that the method of testing by interferometry, when worked out, would have greater accuracy than the method he described, but the complexity of the interferometer method involved the possibility of considerable errors unless the greatest precautions were taken. In other fields of applied optics the adaptation by Twyman of the Michelson interferometer has resulted in a very marked advance in the testing of lenses and other optical apparatus. Perry, Butkow, and Kingslake have contributed to the study of the indications given by the lens-testing interferometer, whilst Smith has added important facts relating to the theory of the instrument. In general, it has been shown that the calculation of aberrations from interferograms is very satisfactory from the designer's point of view, but that such calculations, particularly in the case of large aperture lenses, are troublesome.

With the exception of the Beck method, the usual tests applied to microscope objectives are of a qualitative nature, and require considerable experience and a high degree of skill if they are to be of practical use. The object, therefore, of the present paper is to describe an interferometer method by which the nature of the aberrations and the position of the foci of different zones of a microscope objective can be determined without introducing the complexity and troublesome calculations usually associated with such methods.

The Hilger microscope interferometer, designed and described by Twyman, is the instrument used in the investigation to be described. It was built for Mr. J. E. Barnard, of the National Institute for Medical Research, who required an instrument which could be used as a microscope for ultra-violet photomicrography and as an interferometer for the testing of high-power microscope object-glasses. Owing to the fact that there has been a

great demand on the instrument as a microscope, it has not been possible until recently to determine how far it could be made of service in testing microscope lenses.

In the paper by Twyman a full description of the mechanical details of the instrument is given, together with a number of optical arrangements. Of the latter, only one will be described here. In the diagram shown in fig. 1 a diverging beam of monochromatic light from a point source P is collimated by the lens L_1 and falls upon a transmissively silvered surface R_1 ,

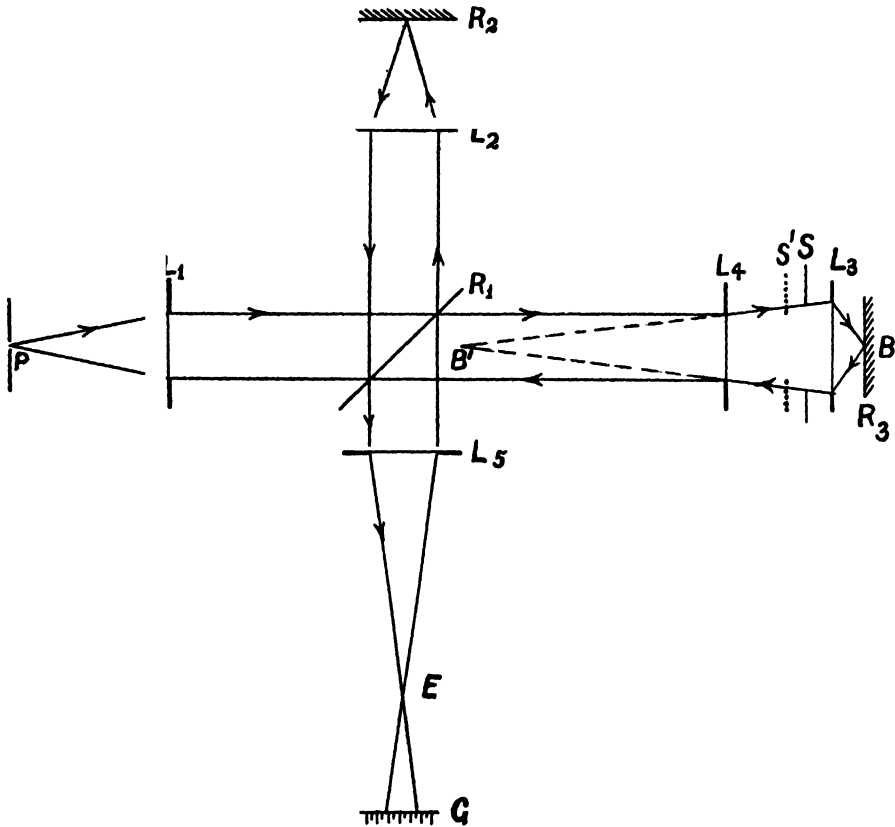


FIG. 1.

by which part of the light is reflected and part transmitted. The transmitted, or test, beam passes through the negative, or tube-length, lens L_4 , which is corrected for spherical aberration, and which can be moved axially over a range of 3 cms. This lens impresses upon the incident beam a divergence equal to the convergence of the image-forming beam of the lens L_3 , the lens under test, when the axial image point B coincides with the focal point of the former (L_4). The diverging beam enters the lens under test, and is brought to a focus at the axial point B on the plane of the reflector R_3 ; B and B' are thus conjugate points of the lens L_3 , and, providing

the lens is free from spherical aberration, each ray is then reflected along a path axially symmetrical with the path before reflection. If spherical aberration be present, and B and B' be conjugate points for some particular zone of the lens, then only the ray passing through that zone will be reflected along an axially symmetrical path.

That part of the beam reflected by R_1 , and termed the comparison beam, is brought to a focus upon the plane reflector R_2 by the spherically corrected lens L_2 , so that, on reflection, each ray traverses a path axially symmetrical with its original path. Plane waves, therefore, leave the lens L_2 and part of their energy is transmitted by R_1 to combine with that part of the energy in the test beam reflected by it. These two sets of waves are then brought to a focus at E by the lens L_5 . Under suitable conditions an observer, placing his eye at E, will see an interference pattern, which will approximate to a contour map, the scale being in half-wave lengths, of the distortion of the image-forming wave surfaces of the lens L_3 . It is essential that the pattern should be of the greatest possible brilliancy and contrast. To effect this, the pinhole P is illuminated by monochromatic light of high

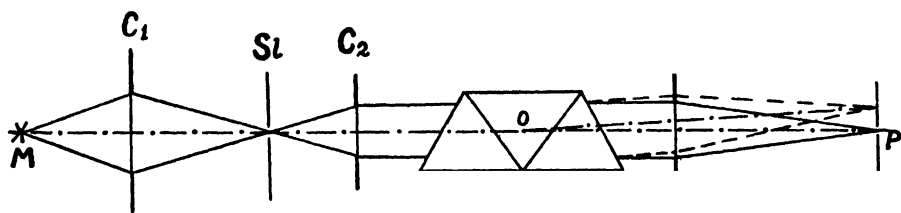


FIG. 2.

intensity, so that the diameter of the source may be as small as possible without impairing the visibility of the fringe system. By using the monochromator shown diagrammatically in fig. 2 it was found that the diameter of P need not exceed a tenth of a millimetre, and that the visibility of the pattern was considerably greater than when a light filter was employed. The illuminating system consists of a condensing lens C_1 , which focuses light from a mercury vapour lamp M upon a slit Sl. The light diverging from this is collimated by the lens C_2 , and enters a direct vision prism which disperses the colours in the incident beam. The lens C_3 brings these colours to a focus in the plane containing P, the result being a number of well-separated spectral images of the slit. If the system from the source to the direct vision prism be mounted so that the whole rotates about O, the optical centre of the prism, the different monochromatic images can easily be made to coincide with P. In this way the interference patterns produced by different colours may be quickly compared. It should be noted that when making this comparison the position of the negative lens must be adjusted to compensate for its lack of chromatic correction. This presents no difficulty, since the makers have determined the necessary adjustments

which should be made when mercury green light is used as a standard of reference.

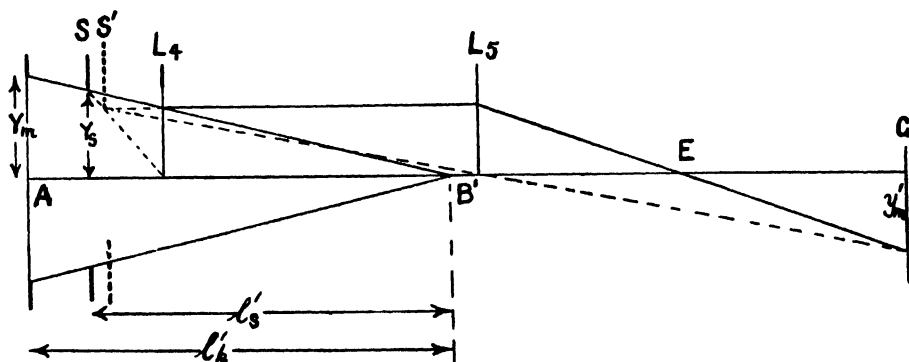
It is usual to obtain photographic records of the interference patterns, and to determine from measurements made upon them the aberrations of the system under test. The following method, however, when applied to microscope objectives, has been found to give results with greater accuracy and ease. Measurements are made by direct observation, by placing a micrometer eyepiece with the field lens removed behind the focus E of the lens L_5 , which is of shorter focal length than that of the original lens supplied by the makers. By suitably adjusting the separation of L_5 and the scale G of the eyepiece, a sharp image of the edge of the stop, which limits the effective back aperture of the objective, can be obtained in the plane of the scale, and thus the interference pattern will be bounded by a well-defined edge. If the viewing system is focused upon any other plane of the test beam, it will be found that the edge of the pattern is indistinct, and that diffraction fringes, which may easily be mistaken for fringes of the interference pattern due to the stop, make their appearance. The plane containing the stop may therefore be used as the reference surface when determining the zonal aberration of the system under test. Actually the surface to be preferred is a plane perpendicular to the axis of the system at the pole of the last surface. By means of this type of observing system an interference pattern, larger than that seen when placing the eye at the focus of the original lens, can be observed. It was found that the fringes, which were clearly visible at the outer zones of the pattern when the viewing system just described was employed, were either absent, or only faintly visible by the simpler method of observation.

Delicate adjustments are provided for focusing the system to be tested, and for any predetermined position of the negative lens—that is, for any determined position of B' a real image of the source can be produced at infinity. When similar adjustments are included in the camera lens interferometer, on which the system to be tested is mounted so that the image space is occupied by the reflector, known displacements of the mirror can be made, and from these the zonal aberrations of the system determined. In the present case, since the reflector R_3 is in the object space, the determination of the aberrations in this way can be of use only in the case of lenses which have been designed by computing the paths of rays starting from the axial image point. It is altogether different, however, with immersion objectives where the ray tracing begins in the object space. In order to determine the aberrations in the image space, it is possible to displace the negative lens through intervals of 0.01 mm. so that its focal point can be made to coincide with the focus of any zone of the lens under test.

Since the plane of the stop and that containing the eyepiece scale are conjugate planes of the system L_4, L_5 , it follows that the interference pattern is really a contour map of the distortion of the waves as they arrive at the

former. The nature of the distortion may be determined when the path of the comparison beam is lengthened by applying slight pressure to the carriage on which the reflecting system $L_2 R_2$ is mounted. Under certain conditions the fringes will originate or disappear at some intermediate zone of the pattern. This indicates that, at the corresponding zone of the stop, the path difference between the ideal wave converging on B' (fig. 1) and the actual wave is a maximum, or a minimum, and that B' is the focal point of that zone of the lens which produces this degree of distortion. The radius of this zone may be obtained by tracing, in the reverse direction, a geometric ray which passes through the above zone of the pattern, and which coincides with the path of an element of the wave surface where the distortion is a maximum or a minimum.

When there are two such zones in the pattern, the focal points of the corresponding zones of the lens are coincident at B' . For one the distortion is a maximum; for the other it is a minimum. Further, the ratio of the



radii of the zones in the pattern will be equal to the ratio of the radii of the corresponding zones of the lens under test. It has already been pointed out that the most suitable plane of reference is one which is perpendicular to the axis of the system under test, and which passes through the pole of the last surface. The radii of the zones of the lens are determined in this plane.

Since between the negative lens and the lens L_5 the path of any ray which converges on B' after leaving the lens under test is in a direction parallel to the axis, simple mathematical expressions, which give the ratio of the zone from which the ray emerges to that of the maximum aperture, may be obtained.

In fig. 3 the planes containing the stop S and the scale G are shown to be conjugate planes of the system $L_4 L_5$. Let B' be the paraxial image point of the lens under test, and let its distance from the stop and the pole of the last surface be l'_s and l'_k respectively. Let Y_m be the maximum

effective back aperture of the lens with reference to the plane AP, and let Y_z and y'_m be the radius of the stop and of its image respectively.

Then the scale reading

$$y'_m - Y_m = \frac{Y_z \cdot l'_k}{l'_s} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Y_z , l'_k , and l'_s can be determined by direct measurement for any position of the negative lens. The lens under test should be so adjusted that the points B and B' in fig. 1 are conjugate to one another for the paraxial zone; but as it is impossible to ensure that this shall be so, the lens is adjusted until the largest possible aperture free from fringes is obtained. Should it happen that B and B' are conjugate points of an intermediate zone having a radius of Y_z , the ray from this zone will finally intersect the plane of the scale at a distance y'_z from the axis such that

$$\frac{Y_z}{Y_m} = \frac{y'_z}{y'_m} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

From equations 1 and 2 the value of Y_z can be determined. It is, however, much more convenient to determine the ratio Y_z/Y_m .

$l'_k = 159.6 \text{ mm}$		$= 157.1 \text{ mm}$		$= 154.6 \text{ mm}$		$= 152.1$	
Y_z/Y_m	$\delta (\text{mm})$	Y_z/Y_m	$\delta (\text{mm})$	Y_z/Y_m	$\delta (\text{mm})$	Y_z/Y_m	$\delta (\text{mm})$
0.98^{67}	0.0	0.98^{42}	-0.50	0.97^{86}	0.0	0.95^{79}	-2.00
0.550							
0.98^{51}	+0.50	0.98^{20}	-0.25	0.96^{76}	+0.25	0.94^{89}	-1.50
0.686				0.765			
0.98^{21}	+1.00	0.97^{70}	0.0	0.95^{89}	+0.375	0.94^{41}	-1.25
0.733				0.791			
0.98^{15}	+1.50	0.97^{52}	+0.25	0.95^{01}	+0.500	0.93^{93}	-1.00
0.776		0.654		0.811			
0.97^{75}	+2.00	0.97^{35}	+0.50	0.93^{42}	+0.625	0.92^{93}	-0.75
0.803		0.752		0.850			
0.97^{65}	+2.50	0.96^{97}	+0.75			0.90^{20}	-0.50
0.844		0.783					
0.97^{13}	+3.0	0.96^{33}	+1.00			0.79^{41}	-0.25
0.900		0.801					
		0.95^{15}	+1.25			0.65^0	0.0
		0.832					

To determine the radius Y_z of a zone having its focus at B'_z (fig. 4), a distance $(l'_k + \delta)$ from the plane AP, let the negative lens be moved away from the lens under test through a distance δ . Its focal point will then coincide with B'_z , and the ray from this zone will emerge from it in a direction parallel to the axis. Let the height of this ray above the axis be y_z , and let it intersect the plane of the scale at a distance y'_z from the latter. Further, let a ray converging on B' from the marginal zone emerge from L_4 at a

height y_1 . This ray will pass through the plane of the scale at a height y'_m from the axis of the system. If f is the focal length of L_4 , then

$$\frac{y'_z}{y'_m} = \frac{y_z}{y_1} = \frac{f \cdot Y_z}{(l'_k + \delta)} \cdot \frac{l'_k}{Y_m f}$$

or

$$\frac{Y_z}{Y_m} = \frac{y'_z}{y'_m} \cdot \frac{(l'_k + \delta)}{l'_k} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

When using monochromatic radiation of wave-length $\lambda=5461\text{\AA}$, the following results were obtained for a 3 mm. oil-immersion objective having a numerical aperture of 1.40. This lens is an excellent one, and, when adjusted on the interferometer so that the image distance (l'_k) is 154.6 mm., there is just a suggestion of a fringe on the extreme edge of the field. The wave distortion of the remainder is less than a quarter of a wave-length.

For each value of l'_k in the table the negative lens is adjusted so that its

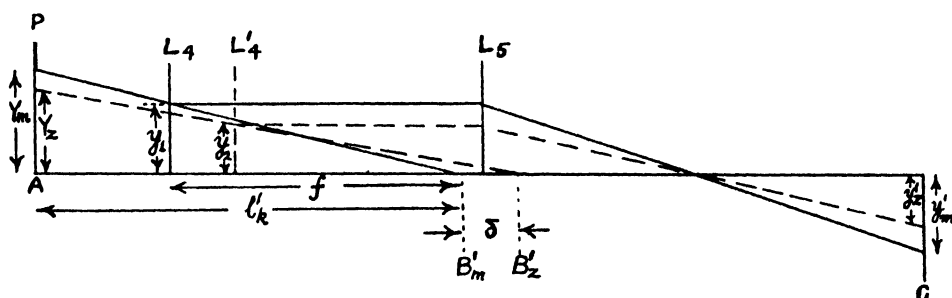


FIG. 4.

focal point is at a distance l'_k from the last surface of the system under test. The latter is then adjusted to produce a pattern which indicates that the wave distortion is less than a quarter of a wave-length over the largest possible diameter of the field. Those zones which have their foci coincident with the focal point of the negative lens, are indicated by giving δ a zero value. The focal point of any other zone is obtained by adding the corresponding value of δ to l'_k .

In fig. 5 the results are shown graphically. The dotted portion of each curve cannot be determined with the same accuracy as the remaining portions, since the zone where the lateral aberration is greatest is that at which inflexion of the wave surface occurs. When the focal point of this zone coincides with that of the negative lens, the fringes on either side of the corresponding zone of the pattern move in the same direction when the path of the comparison beam is lengthened. The only indication that the two foci are approximately coincident is given by the distance between the fringes proximate to the corresponding zone of the pattern becoming a maximum.

The accuracy with which Y_m/Y_z can be determined depends upon the degree of distortion present in the actual wave front. If this is small, the range of zones becomes small, as is indicated by fig. 5. In each of the tests the minimum value, where the accuracy was of a satisfactory order, was found to be greater than 0.5, whilst for $l'_k=154.6$ values less than 0.7 could not be determined with the same degree of accuracy as those given.

No attempt has been made to deal with zonal chromatic aberrations.

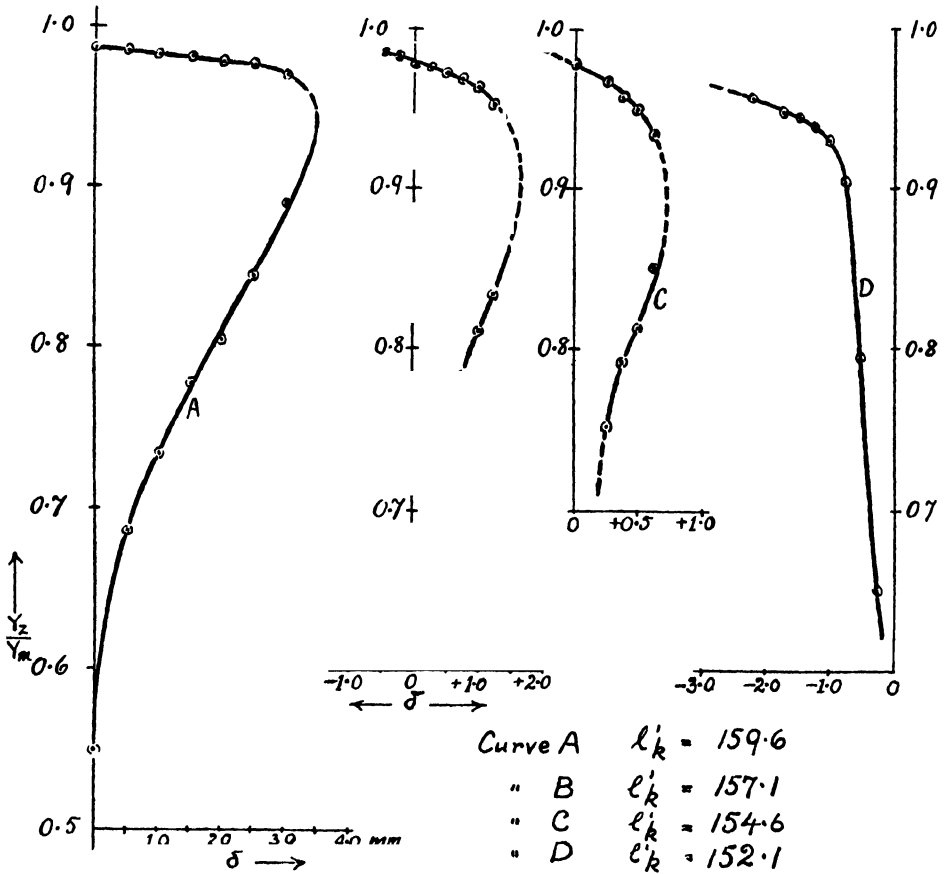


FIG. 5.

The same procedure may be carried out with other wave-lengths provided the pinhole can be illuminated with radiations of sufficient intensity. The testing of lenses of shorter focal lengths will require some modification of the viewing system, since the effective back aperture of these is usually much smaller than that of 3 mm. lenses. This may be effected by choosing for the lens L_5 one of longer focal length, and by adjusting the separation between it and the scale so that a highly magnified image of the stop may be obtained.

In conclusion, I desire to thank Mr. J. E. Barnard, F.R.S., for having placed the instrument at my disposal, and for the interest he has taken in the work.

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XVI.—METALLOGRAPHY AT LOW TEMPERATURES.

By WALTER ROSENHAIN, D.Sc., F.R.S., and A. J. MURPHY, M.Sc.,
National Physical Laboratory.

(Read May 21, 1930.)

TWO PLATES.

ABSTRACT.

METHODS are described for the microscopic investigation of the structure of mercury and amalgams in the solid state. Specimens of the metals are solidified by means of carbon dioxide snow or other refrigerant, and are polished, etched and examined microscopically at temperatures below -40°C . Typical photomicrographs are included.

In the course of an investigation into the constitution of dental amalgams, at present in progress in the Metallurgy Department of the National Physical Laboratory, it became necessary to determine the microstructure of solid mercury and of amalgams which are completely or partially molten at ordinary temperatures.

The melting point of mercury is -38.85°C . In order to make observations on the microstructure of a specimen of the solidified metal, it is therefore necessary to carry out the operations of preparing a plane surface, etching this surface and examining microscopically the structure thus revealed, at a temperature below -40°C . Carbon dioxide snow, by means of which a temperature of -70°C . can be maintained, provides a convenient refrigerant, and has been most commonly used in this investigation. Liquid air has also been employed occasionally.

The present communication gives a brief description of the experimental methods which have been adopted in studying the metallography of solid mercury and amalgams. A more detailed report has been published elsewhere,* but it was thought that the subject might be of sufficient interest to this meeting to justify a short account being given here.

The sample of liquid metal which is to be examined is placed in a small mould, consisting of a glass or ebonite tube, about $\frac{3}{4}$ inch long and $\frac{1}{2}$ inch in diameter, having accurately parallel ends, and closed at one end by a plane glass slip attached to the tube by a thin film of gum. The mercury or amalgam is solidified in this vessel by immersing it in a paste of carbon dioxide snow and acetone. The glass slip is then removed by lightly tapping or prising it off, exposing a smooth flat surface of solid metal.

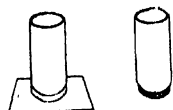


FIGURE 1

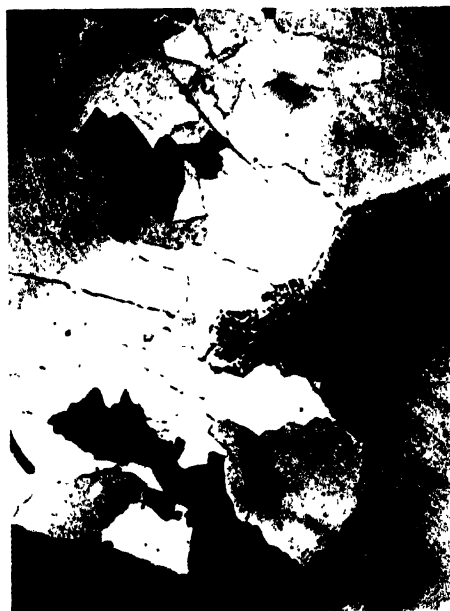


FIG. 3.—0·15 p.c. Tin. $\times 100$.



FIG. 4.—5 p.c. Tin. $\times 100$.

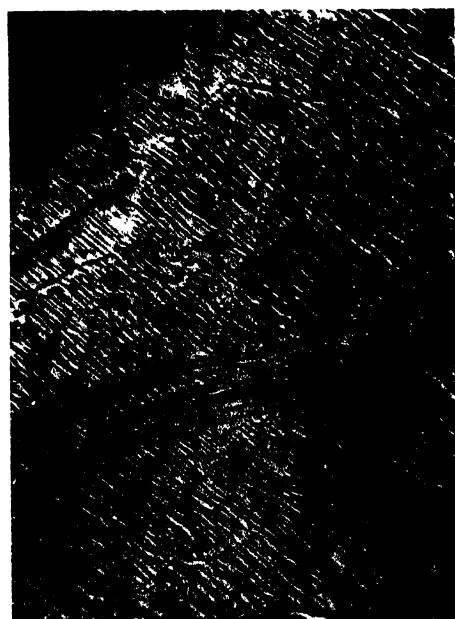


FIG. 5.—5 p.c. Silver. $\times 100$.



FIG. 6.—29 p.c. Silver. $\times 100$.

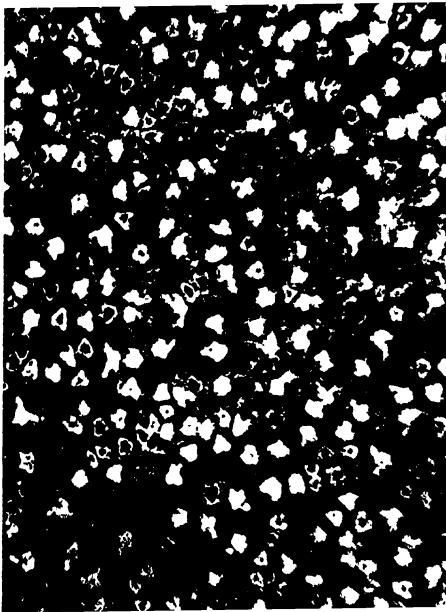


FIG. 7.—15 p.c. Thallium. $\times 100$.



FIG. 8.—Pure Mercury. $\times 100$.

In most cases the surface prepared in this way, which may be described as a cast surface, is entirely suitable for etching without further preparation, but it is sometimes desirable to use a polished surface. In this case, if the mould consists of a glass tube, a glass ring of the same diameter as the tube is interposed between the latter and the plane glass slip. After solidifying the metal in this composite mould, the glass slip and ring are both removed, leaving the surface of the mercury or amalgam standing above the walls of the glass tube. The arrangement of the mould for this purpose is shown in fig. 1. A simpler method, which is generally applicable, is to solidify the metal in an ebonite mould. It is found that the end of the ebonite ring can be polished along with the metal which it surrounds.

The specimen so prepared is held in a clamp made of wood or other thermal insulator and rubbed by hand on strips of emery paper immersed in a paste of carbon dioxide snow and acetone in a porcelain dish. Successively finer grades of paper are used, in the same way as in the preparation of specimens of other metals at ordinary temperatures, care being taken at each stage to wash away, by means of acetone cooled to -70°C ., the particles of coarse emery. The final polishing is effected on a pad of chamois leather, also immersed in the cooling medium. It is generally not necessary to use any polishing powder, though fine magnesia and alumina have been employed. The chief difficulty in the polishing operation is to avoid the presence of particles of ice, which cause severe scratching. At these temperatures solid mercury and dilute amalgams resemble lead at ordinary temperatures in their behaviour during polishing.

In order to etch the solid mercury, a reagent is required which remains liquid at temperatures considerably below -40°C . The most satisfactory etching reagent appears to be a 25 p.c. aqueous solution of hydrochloric acid, which corresponds in composition to a eutectic in the hydrochloric acid—water system, freezing at -86°C . The etching is carried out electrolytically in this solution at about -60°C . After etching, the specimen is washed with cooled acetone. It is not necessary to take any special measures to dry the surface of the specimen—which would be a troublesome operation on account of the low vapour pressure of most liquids at these low temperatures—as the microstructure can be observed quite satisfactorily through a thin film of acetone.

Specimens having a surface produced by casting against glass are etched in from one to five minutes in the case of mercury and dilute amalgams of tin. The dilute silver amalgams are much more resistant to etching by hydrochloric acid, but with higher percentages of silver the amalgams are fairly easily attacked. The polished surfaces of pure mercury and dilute amalgams are not etched so readily as the cast surfaces; indeed, it has not been possible to etch satisfactorily a polished specimen of pure mercury, even when the polishing is carried out in liquid air in order to minimise surface flow. The reason for this apparent passivation is not clear. Silver amalgams containing more than 20 p.c. silver, which are partially liquid

at ordinary temperatures, have been polished and etched successfully at -60°C .

For microscopic observation it is essential to maintain the specimen below -40°C ., and when observations are to be continued for more than a few minutes, it is necessary to prevent the deposition of frost on the surface of the specimen or on the objective lens of the microscope. The arrangement shown in fig. 2 has been devised for this purpose. The usual screwed collar of the objective is replaced by a larger brass collar carrying a tightly-fitting glass tube and provided with inlet and outlet tubes. The specimen stands in an ebonite cell partly filled with carbon dioxide snow and acetone. The wide glass tube projects below the etched surface of the specimen, and, dipping into the cold acetone, provides a sealed chamber surrounding the specimen. A stream of air, after thorough drying and cooling to about -70°C ., passes into this chamber, thus maintaining the atmosphere around the specimen and objective lens free from condensable moisture. The microscope is fitted with a levelling stage and the usual movements. A camera attachment fitted in place of the eyepiece of the microscope is used for photomicrography.

Typical photomicrographs obtained by the use of the apparatus and methods described above are reproduced in figs. 3 to 8.

Fig. 3 shows the structure of an amalgam containing 0.15 p.c. tin, observed on a cast surface, etched electrolytically in hydrochloric acid. Coring is visible in certain of the crystals.

Fig. 4 refers to an amalgam containing 5 p.c. tin. A second constituent is evident in the form of fine particles dispersed through larger crystals of mercury, or of a dilute solid solution of tin in mercury.

In fig. 5, which illustrates the microstructure on the cast surface of a 5 p.c. silver amalgam, an effect is seen which strongly suggests a duplex structure, but it is probable that the microstructure observed is partly due to a relief effect caused by abnormal chilling during solidification of the amalgam.

With 29 p.c. silver in the amalgam, the specimen is readily etched after polishing, although immediately after casting it contains a large proportion of free mercury. A specimen in this condition, polished and etched at -60°C ., is seen in fig. 6.

Fig. 7 shows the structure of an amalgam containing 15 p.c. of thallium, consisting of primary crystals of the compound Hg_2Tl in a background of the eutectic, which contains 8.5 p.c. thallium and melts at -60°C .

Fig. 8 shows a system of slip bands developed in pure unetched mercury by compression.

The experimental methods described in this paper have been developed in the course of an investigation on behalf of the Dental Investigation Committee of the Department of Scientific and Industrial Research, and with the aid of funds provided by the Dental Board of the United Kingdom. The authors desire to thank the Committee for permission to publish this account of the work.

XVII.—ILLUMINATION OF METALLURGICAL SPECIMENS.

By CONRAD BECK, C.B.E., F.R.M.S.

(Read May 21, 1930.)

TWO PLATES.

METALLURGICAL specimens, having been polished and etched, can be illuminated on two different systems :—

- (1) Internal or so-called *vertical illumination* (fig. 1A), in which the beam of illuminating light passes down the microscope through the object-glass on to the specimen. It is reflected by the polished metal, which acts as a mirror. Those portions of the specimen which are not polished, and which may be termed the structure of the object, scatter the light and appear dark against a brilliant polished surface.
- (2) External or *oblique illumination* (fig. 1B), in which none of the light which is reflected from the polished surface can enter the microscope, and the scattered light from the structure is all that can enter, and it appears bright on a dark field.

The chief difference in the two methods is that the structure that appears dark on a bright field with vertical illumination appears bright on a dark field with oblique illumination.

There is, however, another difference which requires further investigation. Some of the structure shown by the one method does not correspond with that shown by the other. It may be that the external oblique illumination shows more of the contour of the surface, while the vertical illumination shows more clearly discoloration produced by the etching, which probably extends to a distance below the surface.

The subject is of some importance, and it may be that Carl Benedick's method of illumination may throw some light on the subject.

Vertical illumination, however, being the plan in almost universal use, requires most consideration.

There are two types of vertical illuminators (fig. 2), the transparent thin glass reflector and the opaque reflector, either a prism or an opaque silvered mirror. For high-power work the transparent thin glass reflector has great advantages, as it gives the full resolution of which the object-glass in use is capable. The prism reflector, which makes the aperture of the object-glass

half the size and of a D shape, only gives about half the full resolution of the object-glass.

The image of a point produced by an object-glass with a circular aperture is not a point, but a very small diffraction disc, and the resolution or sharpness of an image depends on the size of this disc. All objects may be considered as masses of points in close formation, and the smaller the disc, the less overlapping of these minute discs there will be.

The image of each point produced by the object-glass, if its aperture is reduced by cutting it in half with a prism, is an ellipse about twice the length of the circular aperture disc, and thus in one direction the resolution is reduced to one-half, and a form of indistinctness is produced, due to the shape being elliptical instead of circular, which means that the performance of the object-glass is reduced to at least half its proper value. With low and moderate powers, where the resolution is generally in excess of what is actually required, that is not so important, and a prism illuminator gives greater light than the transparent reflector, but with high powers the prism illuminator will not give the best results. These remarks apply to the prism reflector, which cuts the aperture of the object-glass in half.

A study of the shapes of the diffraction images of a point formed by apertures of different shapes leads to the conclusion that small opaque mirrors or prisms that do not cut the aperture in half, but that only obscure a comparatively small portion of the aperture, make but slight modifications in the size and shape of the diffraction disc. In practice it will be found that small silvered mirrors only partially projecting into the aperture of the object-glass give high resolving power, but it is difficult to fill the whole of the unobscured aperture by their means.

The best use of the transparent thin glass reflector, however, becomes the most important matter for discussion.

In a paper which I read before this Society in March, 1927, I drew attention to the similarity between the illumination of transparent objects with a substage condenser and that with vertical illumination, in which the object-glass itself became its own condenser. From this it followed that the light must be centred. It should fill the whole aperture of the object-glass. It should be in focus on the specimen.

As the object-glass forms an image of the object in the eyepiece, the light, or image, of it should be at the same distance from the reflector as the eyepiece. It will then be in focus on the object. This is, so called, critical illumination, and when the object is a mirror, it is the only way by which the whole aperture of the object-glass can be adequately utilised. The upper diagram, fig. 3, shows one method of critical illumination in which an image of the source of light is projected by a condenser to a position at the same distance from the reflector as the eyepiece.

But, having considered the theoretical conditions of the best illumination, the troublesome question of glare arises. In vertical illumination glare can never be completely eliminated; light which passes through lenses must

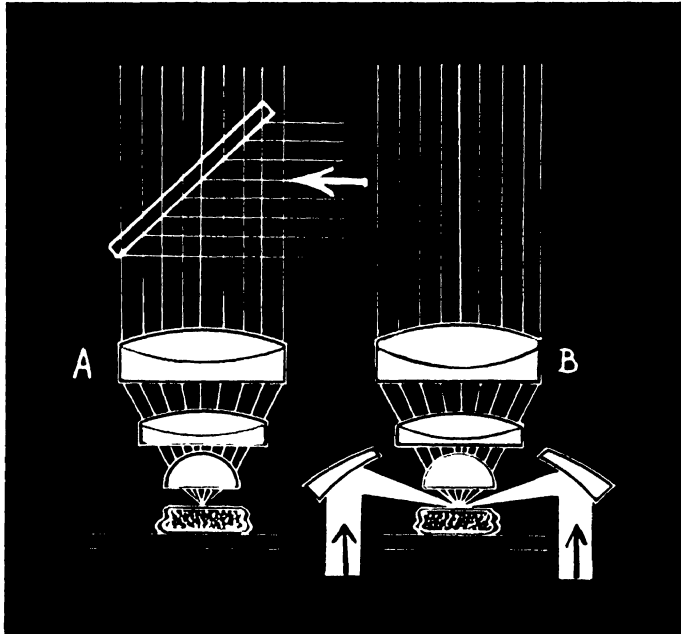


FIG. 1.

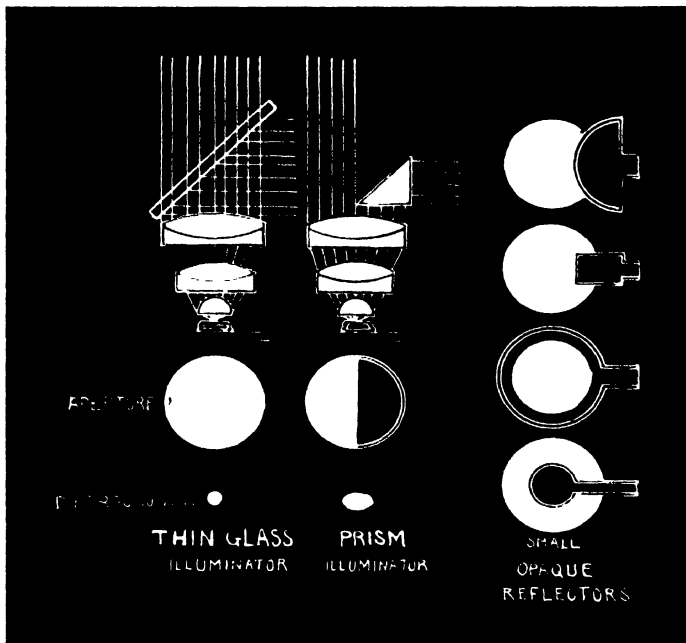


FIG. 2.

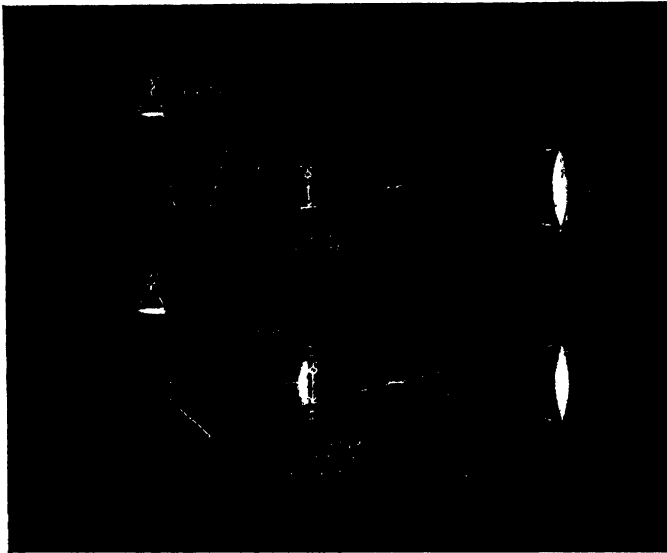


FIG. 3.

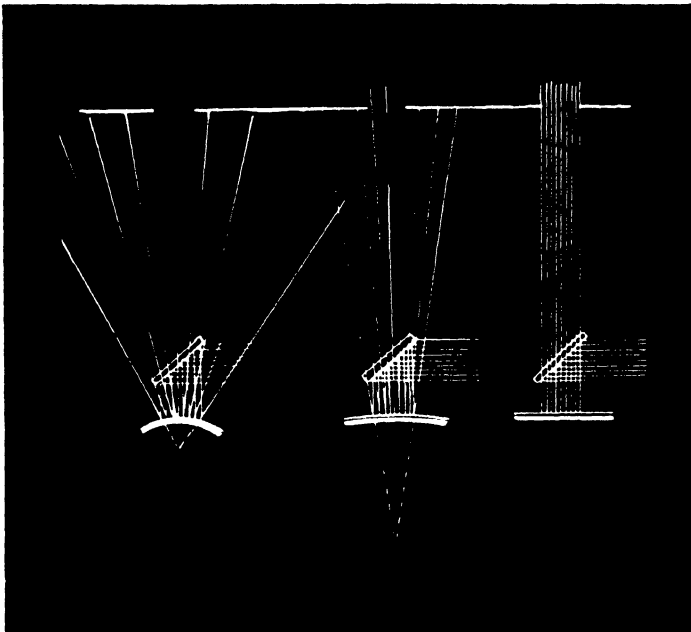


FIG. 4.

be partially reflected back. It can, however, be greatly modified. Mr. Harold Wrighton was, I believe, the first to demonstrate a method of arranging the light so that the illuminating beam was absolutely limited to just that size which was required to do the work and thus get rid of all stray light.

If a suitable collecting lens be placed at the spot where the image of the source of light is formed, as shown in the lower diagram, fig. 3, the second image of the source of light which is focused by the object-glass upon the object is unaffected, but the entire illuminating beam is condensed so as to confine it to a small patch on the back lens of the object-glass. The size of this patch can be limited by an iris diaphragm placed close to the condenser of the lamp, and the beam can be made the size of the whole aperture, half the aperture, or any portion, but no light reaches any portion of the mounting or the edges of the lenses. A large amount of glare in incorrect illumination is due to light reflected from mountings, edges of lenses, etc., reflected back into the microscope by the lenses of the object-glass, and Mr. Wrighton's method eliminates the whole of this. If this form of illumination is employed, glare is reduced to a minimum. There is then no reason for short mounted object-glasses. It is doubtful if they have advantages with any form of illumination, but certainly their only justification could have been from a supposed reduction in glare.

The glare produced by the reflection at the curved surfaces of the lenses of the object-glasses is a complex optical problem. The amount of light reflected from a curved surface of glass does not vary much whatever its curvature, but the proportion that gets into the eyepiece of the microscope is very different. Consider the case of a convex mirror upon which a nearly parallel beam impinges (fig. 4). If it is very highly curved and has a short focus, it is reflected back over a very large angle, and only a small proportion gets into the eyepiece. If it is nearly flat, it is reflected back almost along its original path, so that nearly all the reflected light gets into the eyepiece.

Consequently it is, on the whole, advantageous that the back lens of the object-glass should be a highly-curved convex surface to reduce glare, but a complete consideration of all the reflections of the intricate series of lenses forming a high-power object-glass is too elaborate to enable any laws to be laid down on the subject. All that can be said is that some lenses are better than others in this respect.

Metallurgists might, however, remember that they are more fortunate in the use of vertical illumination than those who desire to examine unpolished surfaces by this means. The metals being examined will generally take a good polish. If the polish is of a high order, the light reflected from it is so brilliant compared with that from the lenses that glare ceases to be of serious moment.

This raises the interesting question as to whether the ultra-violet microscope, which has so largely increased the resolving power of the ordinary microscope, will or will not be of the same value to the metallurgist. As

most of the common metals have not the same reflecting power for ultra-violet as for visual work, the question of glare may be much more serious.

This brief survey of the subject of metallurgical illumination suggests that it would be of service to the metallurgical profession if a research on this question could be undertaken.

The Wrighton-Beck method of illumination has perhaps solved the problem where the highest resolution with high-power immersion lenses are used. It gets rid of almost all adjustments and enables the best results to be obtained with regularity as a routine process, but this only applies to vertical illumination.

The whole question of oblique external illumination and of the Carl Benedick method would repay very careful study.

Even with vertical illumination the question of the most practical form of illumination when the highest powers are not used requires more consideration than has been given to it.

The thin glass reflector is considered (probably correctly) the only illuminator to be used when the utmost resolution is required, but it must not be forgotten that a prism or an opaque silvered reflector gives far more light, and, if suitable shapes and sizes could be devised, might be arranged so that but slight loss of resolving power would result.

There are several minor points that would arise in such a research, but in this particular research there are difficulties which do not arise in other branches of microscopy. It must be carried out in a metallurgical laboratory because the polished metal specimens must be examined almost immediately after polishing, otherwise they often lose their reflecting power and give unsatisfactory results.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

The Use of Cadmium Fixation for the Demonstration of the Golgi Apparatus.—F. AOYAMA ("Eine Modifikation der Cajalschen Methode zur Darstellung des Golgischen Binnenapparates," *Ztschr. f. Wis. Mikr.*, 1930, 46, 489–91). The cadmium formol method of fixation is suitable for demonstrating the Golgi apparatus in various cells. It succeeds in relatively large pieces. Fix small pieces of tissue in the following fluid for three to four hours:—Cadmium chloride 1 part, formol, neutral, 15 parts, distilled water 85 parts. Rinse quickly in two changes of distilled water and transfer to 1·5 p.c. solution of silver nitrate for 10 to 15 hours at 22° C. Rinse quickly in two changes of distilled water, preferably in a dark room, and transfer for 5 to 10 hours to the following reducing solution:—Hydroquinone 1 part, formol, neutral, 15 parts, distilled water 0·1 to 0·15 parts (sufficient to produce a yellowish tinge). Wash thoroughly in tap water, pass through alcohol, embed and cut sections 3 to 4 μ in thickness. Mount and stain with carmine or hæmatoxylin-eosin. The length of silver impregnation depends on the temperature, and may be regulated accordingly. Epithelial cells of the alimentary tract or of the uro-genital tract require only 1 to 2 hours fixation. Silver nitrate in 0·5 p.c. solution also gives satisfactory results if allowed to act for 36 to 48 hours. Various organs of amphibians, reptiles, birds and mammals may be thus prepared, but those of cold-blooded animals require longer fixation and impregnation than do those of warm-blooded ones. G. M. F.

A New Technique for the Rapid and Certain Demonstration of the Chondriome in the Cells.—A. C. HOLLANDE ("Nouvelle technique pour la mise en évidence rapide et certaine du chondriome dans les cellules," *Compt. rend. Soc. de Biol.*, 1930, 104, 473–4). Pieces of tissue, not larger than 0·5 cm., are placed in the fixative for four hours. The fixative used is Benoit's solution:—Uranium nitrate, 4 p.c. aqueous solution, 4 parts; potassium bichromate, 5 p.c. aqueous solution, 6 parts; mercuric chloride, 5 p.c. in physiological saline, 5 parts; osmic acid, 2 p.c. aqueous solution, 5 parts. After fixation the tissue is placed for 12 hours in a 3 to 5 p.c. solution of formalin in distilled water, then washed in ordinary water for 24 hours. The tissue is then passed through alcohol and toluene, and embedded in paraffin in the ordinary way. When sections have been cut they are first treated with xylol, then for five minutes in a mixture of equal parts of 96 p.c. alcohol and sulphuric ether containing 5 p.c. collodion, and finally in descending alcohols and distilled water. As a stain, Altmann's acid fuchsin is employed in the warm for 30 minutes: the section is then washed for $\frac{1}{2}$ to 1 minute in distilled water and the following technique carried out:—(i) 5 minutes in an 0·5 p.c. aqueous

solution of phosphomolybdic acid; (ii) 10 to 20 minutes in a 1 p.c. aqueous methylene blue solution; (iii) rinse in distilled water (15 seconds); (iv) differentiate in a solution of 80 p.c. ethyl alcohol, previously saturated in the cold for 24 hours with orange G. Differentiation occurs in from 15 to 40 seconds, according to the time of contact with the methylene blue. (v) Wash rapidly in distilled water (10 seconds); (vi) pass into ethyl alcohol (95 p.c.) for 1 minute; (vii) dehydrate in two baths of amyl alcohol for 5 to 10 minutes; (viii) then pass into equal parts of xylol and amyl alcohol; (ix) xylol and mount in Canada balsam. Mitochondria are red, the protoplasm bluish, red or grey, collagen and certain cell granules deep blue, chromatin grey, bluish or rose, nucleoli bright red.

G. M. F.

The Influence of the pH in Fixation by Formol.—C. JACQUIERT ("Influence du pH dans les fixations au formol," *Compt. rend. Soc. de Biol.*, 1930, **104**, 483-5). When the pH varies from 2.8 to 3.1, the cytoplasm is only slightly swollen, the isoelectric point of the cytoplasm being pH 5.7, for the nucleus pH 3.2. When the pH of the fixative is between 3.9 and 4.3, the fixation both of cytoplasm and nucleus is bad, better between pH 5.5 and 6.5, becoming worse at more alkaline values.

G. M. F.

A Method for Demonstrating the Golgi Apparatus.—J. BUBENAITÉ ("Über einige Erfahrungen mit der Golgi-Methode," *Ztschr. f. Wis. Mikr.*, 1929, **46**, 359-60). Fix the tissues for 1 to 2 days in 10 p.c. formalin. Transfer to Müller's solution or 2.5 p.c. aqueous solution of potassium bichromate for 2 days at 34° C. Rinse in 2 p.c. AgNO₃ and transfer to the same solution for 1 to 2 days at 34° C. Embed and mount as usual.

G. M. F.

A Histological Technique for the Serial Sectioning of Small Nematodes.—S. DOUBROW and J. ROUSSET ("Sur un procédé de technique histologique concernant la coupe en série des petits nématodes," *Bull. d'histol. appl.*, 1929, **6**, 416-7). Two difficulties in cutting serial sections through the chitinous sheaths and heterogeneous contents of nematodes are overcome by the following technique:—Fix in modified Schaudinn's solution (HgCl₂ saturated in 80 p.c. alcohol with 5 p.c. acetic acid) for 4 to 12 hours. Transfer to iodized 80 p.c. alcohol for a few days to a few weeks, then through several transfers of 90 p.c. and 100 p.c. alcohol to butyl alcohol for 24 hours. Transfer to the paraffin oven at 56° C. in butyl alcohol saturated with paraffin for 24 hours, and then through one or two transfers of pure paraffin for 24 hours. Embed and stain as usual. Sections 4μ thick were thus obtained.

G. M. F.

A Method for Concentrating and Sectioning Protozoa.—M. S. LUCAS (*Science*, 1929, **70**, 482-3). A vial with a wide mouth and round bottom or the lowest fourth of a test tube is used. The protozoa are allowed to settle at the bottom before changing fluids by pipetting them off with a wide-mouthed pipette to 4 mm. of the level of the protozoan mass. After removing the xylol, melted paraffin is quickly added, while, after completing infiltration, the greater part of the paraffin is pipetted off, leaving enough to cover the specimens. During this process the vial is kept under a heated bulb. As the remaining paraffin solidifies, a portion from the bottom is made to adhere on the tip of a large dissecting needle by moving it gently as the mass cools. The protozoa are now temporarily embedded on the needle-tip. Submerge a paper box, with the four corners open at the bottom, into a watch crystal with melted paraffin under the heat bulb. Lower the temporary block in the box and let it completely melt and fuse with the surrounding paraffin. Allow the protozoa to settle at the bottom and, if well concentrated, they will fall in one small

spot. Specimens with a longer axis are likely to settle with that side against the bottom, thus securing a definite orientation. Lift the box from the crystal and transfer to ice-water after the sides have solidified.

G. M. F.

The Sectioning of Embryological Material.—J. I. DAVIES ("A Method of Orienting Difficult Embryological Material for Sectioning," *Anat. Rec.*, 1929, 43, 381-5). For the early stages of the frog, proceed as follows: Cut a rectangular block of tissue about $8 \times 4 \times 4$ mm., preferably brain kept some time in alcohol, dry with a towel, and with a scalpel dig out a cavity a little larger than the egg, but not deeper than its diameter. Put a drop of Meyer's albumin into the cavity and transfer the unfixed egg, with hardly any fluid in the cavity. Rotate the egg under the binocular microscope so that the yolk egg is uppermost. Gently drop on the fixing fluid; this will coagulate the albumen, and the egg will stay in the desired position. Transfer to fixing fluid to complete fixation. Dehydrate and mount, maintaining the rectangular shape of the tissue. The method is also applicable to various fixed materials, and in that case the objects are transferred from alcohol and fixed with alcohol of the same strength as that in which they have been kept. The advantage in using fixed material is that it can be stained in bulk before embedding in the tissue. The brain is then almost unstained, the effect being similar to that obtained with celloidin embedding.

G. M. F.

The Development of Bacteriological Staining Methods.—H. J. CONN (*Stain Technol.*, 1930, 5, 39-49). In this section on the history of staining, the various procedures used for the demonstration of bacteria are described, commencing with Weigert's use of hydrochloric acid, glycerine, carmine, and the use of hæmatoxylin (1876). The work of Ehrlich and Ziehl is also discussed at length.

G. M. F.

The Application of Dyes in the Cancer Problem.—C. F. GESCHICKTER (*Stain Technol.*, 1930, 5, 49-64). This communication is a theoretical consideration of the necessary qualifications for obtaining a differential stain for cancer cells. The disadvantages of intravital staining are pointed out, and the use of cell suspensions, frozen sections and fixed material is favoured. An analysis of the biological properties peculiar to cancer suggests that there are three characteristics of cancer tissue offering possibilities for differential staining—the cytological structure known as the "plastin reaction," described by Lipschütz, the histogenic cycle of cancer cells, the viability of cancer tissue under anærobic conditions. Modifications of the Giemsa stain are described for application to the plastin reaction, while Congo red and trypan blue might be used as indicators of the survival of malignant tissues because of the failure of these dyes to permeate living cancer cells.

G. M. F.

A Differential Stain for Connective Tissue.—E. E. LARSON ("Further Experimentation with a New Differential Staining Method for Connective Tissue combined with the Ordinary Hematoxylin-eosin Stain," *Stain. Technol.*, 1930, 5, 73-4). Tissues fixed in any of the commoner fixing fluids stained equally well, while paraffin or celloidin sections can be used. Sections are stained for two or three minutes in hæmatein solution, deeply stained preparations being preferable. The hæmatein solution consisted of one gram of hæmatein dissolved in 10 c.cm. of absolute alcohol and added drop to drop to 100 c.cm. of saturated aqueous ammonia alum. After filtering, 25 c.cm. glycerine and 25 c.cm. methyl alcohol were added. After the tissues had been treated with tap water, they were stained with eosin B (0.5 gm. eosin B in 100 c.cm. of 25 p.c. alcohol) for one minute or slightly longer.

The tissues were then passed through the series of alcohols to 95 p.c. and were treated with orange G (0.5 gm. orange G to 100 c.cm. 95 p.c. alcohol) for 15 seconds or less. The tissues were dehydrated with absolute alcohol, cleared, and mounted. The connective tissue fibres are stained yellow. G. M. F.

Absorption Ratios of Biological Stains.—W. C. HOLMES and A. R. PETERSON (*Stain Technol.*, 1930, 5, 63–72). The absorption ratio is defined as the ratio of the extinction coefficients of the solution of a coloured substance at two specific wave-lengths. If the wave-lengths employed are selected on opposite sides of the absorption maximum of the colouring matter, the absorption ratio defines the spectral position of the absorption band. If they are selected on the same side of the maximum, it defines the gradient of the slope of the band within the region of measurements. In either instance the absorption ratio affords a means of differentiating between different dyes. Absorption ratios are supplied for most of the dyes used as biological stains. G. M. F.

Cytology.

Cell Chemiotaxis.—E. FERNANDEZ GALIANO ("Sobre el concepto de quimotaxis de las células," *Mem. de la real Soc. espan. de Hist. nat.*, 1929, 15, 867–71). The writer believes that there is no such thing as positive chemiotaxis, but that when two fluids, one of them containing organisms, are brought in contact, one or other of the fluids tends to expel the organisms. G. M. F.

Protoplasmic Viscosity and Biological Reactions.—W. STILES ("Viscosity of Protoplasm as Determining the Rate of Biological Reactions," *Biol. Rev.*, 1930, 5, 171–5). A review of the available data shows that in solutions of non-electrolytes and in heterogeneous systems the coefficient of diffusion of substances is not inversely proportional to the viscosity of the medium. Consequently there is no basis for Belehrádek's theory, based on such a supposed relation, that viscosity of the protoplasm, by determining the rate of diffusion, determines the rate of biological reactions. G. M. F.

The Behaviour of the Nucleolus during Mitosis in Tissue Culture, with Observations on the Number of Chromosomes in the Hen.—S. SAGUCHI ("Über das Verhalten des Nukleolus bei der Mitose im Kulturgewebe, nebst Bemerkungen über die Chromosomenzahl beim Huhn," *Zytologische Studien*, 1930, 3, 1–47, 9 pls.). An exhaustive account is given of the chromosome number of the chick and of the behaviour of the nucleolus in tissue cultures of chick embryo heart. G. M. F.

Chromatophores.—G. H. PARKER (*Biol. Rev.*, 1930, 5, 59–90, 5 text-figs.). Chromatophores, the parts concerned with the colour changes in animals, are best developed in the cephalopods, the crustaceans and the three lower classes of vertebrates, the fishes, amphibians and reptiles. In the cephalopods chromatophores are really diminutive organs in that each one consists of a central coloured cell which is expanded against its own elasticity by radial muscle fibres. In the crustaceans a cellular complex, often with several colours, makes up each chromatophore. This expands and contracts slowly, and thus changes the tint of the animal. In the vertebrates a coloured background in the skin is exposed to view or covered up by motile black pigment cells whose melanin granules are made to migrate within the containing cell. Most animals show relatively uniform changes of colour, but in a few, as, for instance, flat-fishes, a pattern may be imitated showing that the central control of the chromatophore system must be somewhat differentiated in the direction in which the musculature is. G. M. F.

The Effects of Temperature on Chromatophores.—D. C. SMITH ("The Effects of Temperature Changes upon the Chromatophores of Crustaceans," *Biol. Bull.*, 1930, **58**, 193-202). Expansion of the chromatophores of *Macrobrachium acanthurus*, a Cuban shrimp, follows immersion of these animals in fresh water at any temperature between 6° and 15° C. or between 35° and 40° C. This reaction occurs regardless of the background upon which the shrimp is placed. Between 15° C. and 35° C. the chromatophores of this shrimp expand when the animal is placed upon a black background, and contract when the animal is placed upon a white background. In blinded and chloretonised shrimps the chromatophores are expanded, and this expansion is in no way altered by changes in background and temperature. Neither high nor low temperature has any effect upon the potency or manufacture of the chromatophore-contracting substance elaborated by the eye-stalks. G. M. F.

The Effects of Mercuric Chloride on the Eggs of Arbacia.—L. HOADLEY ("Some Effects of $HgCl_2$ on Fertilised and Unfertilised Eggs of *Arbacia punctulata*," *Biol. Bull.*, 1930, **58**, 123-44, 5 text-figs.). Mercury has an effect upon the egg of the sea-urchin, *Arbacia*, unlike that found in the case of any of the other metallic chlorides investigated. Acting first on the cortical region, it activates membrane elevation. After longer exposures it has a direct effect upon the pigment, which has mercury-avid properties. The pigment reacts to the mercuric solution by accumulation and subsequent extrusion at a localised point or points on the surface of the egg. The extrusion of the pigment is accompanied by a cytolysis of the pigment granules and the associated cytoplasm. The development of the zygote is retarded and its viability is lowered by the action of the mercuric solution. G. M. F.

Cleavage in the Egg of Chætopterus.—D. WHITAKER and T. H. MORGAN ("The Cleavage of Polar and Antipolar Halves of the Egg of *Chætopterus*," *Biol. Bull.*, 1930, **58**, 145-9). These experiments indicate that the antipolar lobe-formation is not an essential part of the cleavage pattern, but a by-product of that pattern; its absence from the polar fragment and its presence in the antipolar fragment remains to be explained. G. M. F.

Mitochondria in a Sporozoon.—E. S. HORNING ("Mitochondrial Behaviour during the Life-Cycle of a Sporozoon (Monocystis)," *Quart. J. Micr. Sc.*, 1929, **73**, 135-43, 1 pl.). Mitochondria are capable of arising *de novo* in the freshly liberated sporozoite stage of the life-cycle of Monocystis. Mitochondria are present in large numbers throughout the course of the asexual phase of the life-cycle. During the conjugation of the gametocytes the rod-like mitochondria give rise to numerous spherical bodies. At fertilisation the mitochondria within the gametes appear to fuse, resulting in the formation of larger clumps. At the beginning of the spore phase the mitochondria gradually decrease in numbers, and are totally absent within the mature spore. Later, the growth of the liberated sporozoite or young trophozoite is accompanied by a reformation and rapid reproduction of mitochondria. The disappearance and reformation of mitochondria during certain stages of the life-cycle may be correlated with their apparent synthetic activity. G. M. F.

Cytological Variations in the Blood of Hens.—W. L. YAKIMOFF and E. F. RASTÉGAÏEFF ("Sur la question des variations cytologiques du sang des poules," *Bull. Soc. Path. exot.*, 1929, **22**, 766-7). Examination of the blood of eleven birds, three to four months of age, has yielded the following information

regarding the cellular elements:—Red blood corpuscles, 2,088,000 to 2,672,000. Leucocytes: Lymphocytes, 58.1 p.c.; polymorphonuclears, 29.1 p.c.; monocytes, 9.1 p.c.; eosinophils, 1.4 p.c.; mast cells, 2.3 p.c. There is a considerable range of variation in the figures for the various types. In leukæmia this variation was even more marked, for on one day 96.8 p.c. were polymorphonuclears; on the following day 99.8 p.c. were lymphocytes. G. M. F.

Histology.

The Transmission of Heart-Water of Sheep by the Bont-Tick.—R. DAUBNEY ("Natural Transmission of Heart-Water of Sheep by *Amblyomma variegatum* Fabricius 1794," *Parasitol.*, 1930, **22**, 260-7, 1 pl., 3 charts). Observations are recorded to show that heart-water of ruminants in Kenya Colony is transmitted naturally by the adult stages of the common bont-tick, *Amblyomma variegatum*. The prepatent period after infestation with infected ticks is about three weeks; after direct blood-inoculation from a reacting animal the period of incubation is usually from nine to twelve days. The findings of Cowdry (1925) with reference to the regular occurrence of Rickettsiæ in experimentally infected animals are confirmed, and the Rickettsiæ demonstrated in these animals agree morphologically with *R. ruminatum* Cowdry. A lesion which has not previously been described is the so-called "satellism" of neurons. This phenomenon may be due to the action of the Rickettsiæ or to that of some normally latent neuro-virus. G. M. F.

New Observations on the Oligodendroglia of the Optic Tracts.—M. LÓPEZ ENRÍQUEZ ("Nuevas observaciones sobre la oligodendroglia de las vías ópticas," *Mem. de la real Soc. españ. de Hist. nat.*, 1929, **15**, 763-72, 8 text-figs.). A description is given of the oligodendroglia of the optic tracts, in which it is shown that it presents identical characteristics with the oligodendroglia of the cerebrum and medulla. There is the usual close relation to the medullated nerve fibres. G. M. F.

The Connective Tissue of the Pregnant Uterus.—I. C. TUDANCA ("Investigaciones sobre el tejido conjuntivo del útero gestante," *Mem. de la real Soc. españ. de Hist. nat.*, 1929, **15**, 671-92, 12 text-figs.). The reticular connective tissue of the human pregnant uterus undergoes hypertrophy and conversion into a collagen-like substance. True hyperplasia does not occur, but the connective tissue network is much simpler in pattern, owing to its being separated up into its constituent fibres. G. M. F.

Variation in the Thyroid Glands of Cats.—E. LOWE ("Seasonal and Sexual Variation in the Thyroid Glands of Cats," *Quart. J. Micr. Sc.*, 1930, **73**, 577-92, 2 pls.). From October to December the glands of male cats all contained large amounts of colloid with a certain amount of new secretion. Increased activity occurred in January and February, but was replaced in March by a more passive condition. From June to August active secretion again occurred. Females from October to December showed a slight degree of activity, but contained less colloid than the males. During the rest of the year the glands of females resembled those of males, and seasonal changes affected both sexes equally. In pregnant females the glands were, on the whole, more actively secreting than those of normal females. G. M. F.

Phagocytosis by Bronchial Epithelium in the Lungs of Mice.—E. S. DUTHIE (*J. Path. & Bact.*, 1930, **33**, 546-51, 2 pls.). Phagocytosis of red blood cells in the bronchi of the lung has been described in a case of extreme passive

congestion in a mouse following irradiation. The phagocytic cells are identified by their morphology and staining, as well as by the compensatory hyperplasia in the surrounding epithelium as being of epithelial origin. Bronchial dust cells have been studied in healthy mice, and a multiplication in the number followed on the inhalation of carbon particles. From the evidence it is considered that these are also of epithelial origin. G. M. F.

Embryology, Heredity, etc.

The Recapitulation Theory and Biochemistry.—J. NEEDHAM ("The Biochemical Aspect of the Recapitulation Theory," *Biol. Rev.*, 1930, **5**, 142-58). As is well known, the chick embryo for a short time in its early development excretes 90 p.c. of its nitrogen as ammonia, then for a short time 90 p.c. as urea, and finally 90 p.c. as uric acid. From the recapitulatory point of view this is suggestive, since marine invertebrates excrete their waste nitrogen as ammonia, fishes and amphibia as urea, and sauria and birds mainly as uric acid. A number of other biochemical data are also in favour of recapitulation, as, for instance, the appearance of hormones in the developing embryo, none being present in the unfertilised egg, whilst they are very deficient in the invertebrates. G. M. F.

The Histophysiology of the Foetal Annexa in Mammals.—P. GÉRARD ("Sur l'histophysologie des annexes fœtales des mammifères," *Biol. Rev.*, 1930, **5**, 114-25, 4 text-figs.). The histophysiology varies in the three different types of placenta, namely, the epitheliochorial, the endotheliochorial, and the haemochorial. The histophysiology of the first is almost unknown. In endotheliochorial placentas the hypertrophied uterine glands contribute considerably to the nutrition of the embryo. The remainder of the substances, at the expense of which embryonic development is carried out, come from the maternal blood, and are absorbed in the region of the placenta by the trophoblastic ectoderm. This absorption is selective. In the case of haemochorial placentas the uterine glands supply little material for embryonic development. The embryotrophic substances are derived from two sources. One of these is the maternal cells, which become filled with reserve inclusions (decidual cells) and are absorbed by the trophoblast. The second source is the maternal blood, which directly bathes the foetal trophoblast. The latter fixes colouring matters injected into the mother, while allowing a certain amount to diffuse into the embryonic mesenchymatous tissue of the placenta.

G. M. F.

The Larvæ of *Ambystoma maculatum*.—W. T. DEMPSTER ("The Growth of Larvæ of *Ambystoma maculatum* under Natural Conditions," *Biol. Bull.*, 1930, **58**, 182-93, 3 text-figs.). Growth in weight of embryonic and larval *Ambystoma maculatum* from the time that eggs are deposited to the period of metamorphosis may be expressed as a single sigmoid curve. The length curve, except for a short period before hatching, when the embryonic axis is curved, is likewise sigmoid. Growth to the time of food ingestion is associated with imbibition of water. Later growth to the time of emergence of the salamanders is correlated with a process in which the percentage of water content decreases. During this period the inorganic constituents gradually increase.

G. M. F.

Growth and Maturation in the Parthenogenetic and Sexual Eggs of *Moina macrocopa*.—E. ALLEN and A. M. BANTA (*Journ. Morph. & Physiol.*, 1929, **48**, no. 1, 123-43, 3 pls., 34 figs.). It has been shown that the sex produced by the parthenogenetic eggs of *Moina macrocopa* is subject to control methods, the

critical period for this control being four hours before the eggs are laid. The cytological evidence shows that the germinal vesicle is probably not formed in the parthenogenetic egg until within the second half of the four-hour period before laying, while maturation occurs towards the end of the period. An attempt was made to find the chromosome mechanism involved and relate these findings with the experimental control of sex, but without success. The number of chromosomes in the female is determined to be $2n=22$, $n=11$, but the number is not fixed in the male. It is evident, however, that the male number is greater than 11, and therefore not haploid. Both in the parthenogenetic and sexual eggs there is only one maturation division, which occurs immediately after egg-laying. During the growth stages of the eggs the chromatin is obscured by a large amount of deeply-staining nucleolar material, which is eventually absorbed into the ooplasm and is presumably nutrient in function. There is no evidence that any portion of the nucleolar material bears chromatin. After the formation of chromosomes a body appears at the periphery of the parthenogenetic egg, which is interpreted as arising from the reorganised nucleolar substance. No corresponding structure is seen in the sexual egg. The body in the sexual egg described by Weismann and Ishikawa (1891) as the Paracopulationzelle is noted, and their interpretation questioned. M. A.

Hypogenitalism in *Rana cantabrigensis*.—TSO-HSIN CHENG (*Papers of the Michigan Acad. of Science, Arts & Letters*, 1929, 11, 369-80, 2 pls.). An adult frog is described with normal male external appearance. The sex apparatus is purely male, but the testes are unusually small, showing some pigmentation and an uneven pitted surface. Vasa efferentia are absent, and the fat body is present only on one side. Microscopically the testes are under-developed, having few spermatid tubules and scanty spermatozoa. The author considers that these cases of hypogenitalism have no relation to sex reversal, since in the adult specimen all organs are typically male, with no female features whatsoever. He considers hypogenitalism may be due to two factors:—(1) failure of the primordial germ cells to migrate to the gonadic region either completely or in sufficient numbers; (2) failure of the germ cells to develop normally owing to some disturbances during critical periods of gonadic development. These two factors cannot be considered the initial causes, but are symptoms of a more fundamental derangement of the germ plasm, either a genetical incompatibility or an adverse environmental condition. M. A.

A New Case of Intersexuality in *Rana cantabrigensis*.—TSO-HSIN CHENG (*Biol. Bull.*, 1929, 57, 412-21, 1 text-fig.). A sexually mature adult is described, male in all external characteristics, and with testes and male ducts. In the testes were found true ovarian cells, though immature and apparently degenerating. One ovum occurred in the left testis, and about a dozen such cells in the right. All the ova were actually situated within the seminal tubules and among the male germ cells. There was no trace of Mullerian ducts. The author maintains that, until more is known about the genesis and genetics of sporadic intersexuality, it is premature to discuss whether the above-described frog is genetically intersexual, genetically male with an initial deficiency of sex-differentiating substance, or genetically female transforming into a male. M. A.

A Case of Hermaphroditism in a Common Indian Frog, *Rana tigrina* Daud, with a Note on the Classification of Hermaphrodite Cases.—J. L. BHADURI (*Journ. & Proc. Asiatic Society of Bengal (New Series)*, 1928, 24, 485-99, 1 pl.). The present case differs from previously recorded ones, where oviducts but no ovaries were present in addition to male organs, in the smallness and abortive

condition of the testes and the relation of the openings of the two urino-genital ducts (male and female) in the cloaca. Testes and male ducts occur on both sides as well as right and left oviducts. The latter are normally developed, with anterior and cloacal openings. Classifications of hermaphroditic cases from earlier records are given, together with a new classification made necessary by the large numbers of specimens described recently. In an appendix brief accounts of previously recorded examples are given in a form which should be valuable for reference.

M. A.

Control of Sex in Cladocera. III. Localisation of the Critical Period for Control of Sex.—A. M. BANTA and L. A. BROWN (*Proc. of Nat. Acad. of Sciences*, 1929, 15, 71–81, 1 text-fig.). Overcrowding of females producing parthenogenetic eggs will cause an animal which would normally produce female progeny to produce males. Experiments were planned to determine the position of the critical period in the development of the eggs during which they were amenable to sex determination. A female produces her first brood during the fourth instar. Females from the same brood, having been heavily corded, were isolated at each instar, and it was found that the critical period lay at the end of the third instar. Isolations carried out during the third instar located the critical period as four hours before egg-laying, since isolation of mothers more than four hours before egg-laying prevents male production by previously crowded mothers. The converse experiment was also carried out of subjecting mothers previously isolated to overcrowding at successive periods before hatching. Since the single maturation division occurs an hour or less before the eggs are laid, the external environmental conditions take effect four hours before the appearance of the chromosomes. It is pointed out that the location of the critical period for the internal environment of the ovarian eggs is impossible, and it may well be that it coincides with or immediately precedes the beginning of spindle formation. External influences may be interpreted in various ways :—(i) A direct action of the environment on the egg and not through a chromosome mechanism ; (ii) an effect through the directing of a sex chromosome coupled ; (iii) an effect through a more deeply-seated and fundamental mechanism to which the sex chromosome mechanism is subordinate.

M. A.

Control of Sex in Cladocera. IV. Relation between the Rate of the Mother's Development and the Sex of her Young.—A. M. BANTA and L. A. BROWN (*Physiological Zoology*, 1929, 2, 302–8, 2 text-figs.). This is a further inquiry into the effect of crowding upon the sex of the young produced by parthenogenetic females of *Moina macrocopa*, with a view to determining the effect of crowding upon the females themselves. Data are given of the effect of different degrees of crowding, sex of young, and time of release of young, since it appears that the rate of the mother's development is a factor concerned. The increased male percentages were induced by employing greater crowding of mothers, and consequently a greater concentration of excretory products. It was found that the male percentage increased with greater crowding, and that the greater the delay in the release of the young, the higher the proportion of mothers producing males. That the production of males is associated with a slower rate of development of the mothers is shown by the fact that in bottles containing from 2–36 mothers the amount of retardation in the average time of release of mothers' first broods is proportional to the numbers of mothers in a bottle, and the percentage of males produced by these mothers is proportional to the amount of retardation.

M. A.

Control of Sex in Cladocera. V. Experimentally Accelerated Development of Mothers and Sex of Young ; Mammalian Endocrine Substances without Specific Effect on Cladocerans.—A. M. BANTA and L. A. BROWN (*Physiological Zoology*, 1929, 2, 309–21, 1 text-fig.). The data presented in this paper were obtained in an effort to produce, by means of treatment with stimulating substances, acceleration of development of crowded *Moina macrocopa* mothers, and hence a reduction in number of male offspring. Ethyl alcohol (light dosages), the filtrates of dried adrenal cortex, thyroid, thymus, and muscle tissue increased the rate of development of mothers and materially reduced the numbers of males produced by such mothers. The specific effects of endocrine substances on invertebrates are discussed. Since the filtrate of dried muscle had the same effect as the glands used, it is concluded there is no specific effect, and the observed effects are probably due to changes in the bacterial flora which serves as food for *Moina macrocopa*. M. A.

Unisexual Progenies and the Sex Chromosome Mechanism in Sciara.—CHARLES W. METZ and M. LOUISE SCHMUCK (*Proc. of Nat. Acad. of Sciences*, 1929, 15, 863–6). Previous work by these authors has shown that the sex of the individual fly depends on the type of sperm fertilising the egg, but that, as regards the eggs of any one female, the type of sperms so functioning is in turn predetermined by the zygotic constitution of the female herself. In the present paper evidence is considered which indicates that both of these—the sex of the individual fly and the sex of the progeny as a whole—are “determined” by the sex chromosomes, and that three different kinds of sex chromosomes are involved. The data are obtained from the behaviour of two sex-linked recessive mutant characters, “swollen wings” and “narrow.” Females homozygous for swollen are male producers, while their heterozygous sisters produce females. The same results with the character “narrow.” It is concluded that:—(1) the male is XY; (2) the male-producing female is homozygous, for the X found in the male hence is XX; (3) the female-producing female has one X of this kind, and a chromosome X' which differs from X in respect of the agent responsible for “sex of progeny.” The X' chromosome descends directly from mother to daughter, but goes to only half the daughters. The following conclusions on the relationship between X and X' are put forward:—(i) XX females, X'X females, and X'X' females appear to be indistinguishable somatically, except by the introduction of mutant characters; (ii) XY males and X'Y males are likewise similar; (iii) X' carries the normal lellomorphs of the sex-linked mutant genes thus far detected in X.

M. A.

Heredity and Longevity.—C. B. DAVENPORT (*Proc. of Third Race Betterment Conference*, 1928, 15–18). In this article Dr. Davenport reviews the variation in individual longevity and the factors which influence it. The highest death rate occurs before birth. It is probable that all intra-uterine deaths are due to lethal factors. The death-rate declines rapidly after the first few months following birth, continuing to do so up to puberty. It rises then for a period, but declines at middle age, and rises again gradually to old age. The incidence of death follows definite laws of heredity. This may be due to factors for the resistance of disease which have been shown to be inherited experimentally. Duration of life may not be a biologically separate character, but depends upon an inherited constitution. There is evidence, however, that in some cases genetical factors govern immunity, e.g., the antibodies of the blood, which arise independent of any acquired immunity, but are genetically determined.

M. A.

Are there Genetically-Based Mental Differences between the Races?

—C. B. DAVENPORT (*Science*, 1928, **68**, no. 1773, 628). In this article a brief account is given of a number of mental tests carried out on negroes, whites and hybrids between them, all living on about the same social level and having approximately the same education. It is concluded :—(1) that races differ in innate mental traits as really as they do in physical characters ; (2) the negroes show a superiority over the whites in tests involving sense discrimination and memory, but in tests involving common sense and logical reasoning the negroes were inferior ; (3) the hybrids seem to be strictly intermediate between the blacks and whites. This is the more remarkable since, for example, in rural Jamaica the browns share identical conditions with the blacks, but maintain this different mental level. There seems, therefore, to be a constitutional, hereditary, genetical basis for the difference between the black and white races in mental tests, and hence racial differences in mental traits.

M. A.

Intersexuality in *Rana cantabrigensis*.—Tso-Hsin Cheng (*Journ. Morphology & Physiology*, 1929, **48**, 345–69, 5 text-figs.). The specimen described presents a typical intersexual condition, the first recorded in *R. cantabrigensis*, in which not only the primary sex characters, but also the accessory sex organs and the secondary sex characters are of a mixed type. Wolffian ducts, vasa efferentia, and vesiculæ seminales are present ; also Mullerian ducts, poorly developed, but with a separate opening to the cloaca. Both gonads are ovotestes, one having a large amount of ovarian tissue. Both ovarian and testicular tissues are morphologically normal, but functionally under-developed, since no mature spermatozoa are developed, and the ova show no signs of the vitellogenesis normal to ova at the season. Stromal hypertrophy is distinct, and is probably a functional factor in the development of the spermiatic tissue. The specimen was probably undergoing transformation from femaleness to maleness. Although the frog was two or three years from metamorphosis, one gonad had still a predominant amount of ovarian tissue, and the author does not consider that this case supports Crew's contention of the absolute and rapid dominance of the male substance. There are indications that, under suitable environmental conditions, both sexes can exist together for some time.

M. A.

Intersexuality in Tadpoles of *Rana cantabrigensis*.—Tso-Hsin Cheng (*Papers of Michigan Acad. of Science, Arts & Letters*, 1929, **11**, 353–68, 2 pls.). The author gives a description of nine intersexual tadpoles, between the ages of 38 days and 77 days, so that the intersexual condition is traced back to a very early stage of sex differentiation. In all nine cases ova were found in considerable numbers in the testes, some exhibiting degenerative processes, but many being in various phases of oogenesis. He claims that these cells are true ova, and not formed by the liquefaction of spermatozoa, since they are in all stages of the synaptic phase and a seriation of maturation phenomena is a female characteristic. In addition, these cells always occur in a cortical position, and do not undergo meiotic divisions, but enter a second growth period. The internal and external appearance suggest an increasing prevalence of male characteristics relatively to the time of development, indicating a transformation towards maleness. In an attempt to explain the occurrence of intersexes the author suggests that these cases are intersexes from the beginning of sex development. This may be due to a genetical defect ; any external or internal factor might lead to sex reversal, which always seemed to be in the male direction. A persistence of larval intersexuality would lead to adult hermaphroditism.

M. A.

A Study of the Rate of Oxygen Consumption of Different Cladocera Clones derived originally from a Single Mother.—V. OBRESHKOVE and A. M. BANTA (*Physiological Zoology*, 1930, 3, 1-8). Among cladocera clones derived from a single clone (i.e., a parthenogenetic strain derived from a single mother), and propagated entirely by parthenogenesis, morphological and physiological mutations occasionally arise. Three such clones, one normal and two mutant, exhibiting relatively low vigour and low reproductive capacity, were used in a study of their rates of oxygen consumption by means of a respirometer modified from Fenn's modification of Thunberg's apparatus. The normal clone was found to have an oxygen consumption of 133 times 10·7 cc. per individual per minute, while the reproductively weaker mutant clones had rates respectively of 76 and 72 times 10·7 cc. per minute. Hence the reproductively weaker clones consumed oxygen only slightly more than half as rapidly as the normal "sister"-clone. M. A.

Mollusca.

The Freshwater and Amphibious Gastropod Molluscs of the Indawgyi Lake and of the Connected Freshwater Areas in the Myitkyina District, Burma.—H. S. RAO (*Records of Indian Mus.*, 1929, 31, pt. iv, 273-300, 9 text-figs.). This lake, with the various channels, streams and pools, is connected with the Irrawaddy River system of Upper Burma. The collections were made by Dr. B. Chopra in the cold season of 1926. The physical conditions of the lake do not favour the growth and differentiation of a varied molluscan fauna; there are fewer species present than would be expected, but some of these are very rich in individuals. Twenty-two species were found, of which six are new. Descriptions of two new species of *Paludomus* from Lower Burma are included in the paper, as they are closely allied to two new species here described. The genera represented are *Viviparus*, *Pila*, *Digoniostoma*, *Parafoissarulus*, *Bithynia*, *Acrostoma*, *Melanoides*, *Paludomus*, *Limnæa*, *Planorbis* (*sensu lato*) and *Succinea*. Their distribution outside Burma is described. Excluding the new species here mentioned, the proportion of species peculiar to Burma is small. An ecological table shows the species occurring in the different types of water. Few are exclusively lacustrine, but fewer exclusively fluviatile. Molluscs are not found in the deep central parts of the lake. It is noted that one form of the *Viviparus* is dimorphic, but we do not find that this dimorphism has been shown to be sexual, as might be suspected. The natives eat the *Viviparid* and *Ampullariid* species by breaking an aperture in the shell and sucking out the contents. The only common *Melania* is *M. tuberculata*. The figures are not provided with indications of the degree of magnification, which has therefore to be inferred from statements in the text. "The high power of a binocular microscope" is a rather indefinite measure of magnification. What are "bacterial vela" in the shell of *Hippeutis*? The "amphibious" molluscs are represented by a single specimen of *Succinea*. These snails may exist in considerable numbers in a locality without being observed by the collector on a first visit. E. W. B.

Anatomy of *Mysorella costigera* Kuster.—R. V. SESHAIYA (*Records of Indian Mus.*, 1930, 32, pt. 1, 1-28, 27 text-figs.). There are not many recent observations on the anatomy of the small molluscs of the *Bithynia* group, and this contribution to scientific knowledge appears to be very well drawn up. A description of anatomy in which the histology is not entirely neglected or taken for granted is a welcome improvement on the type in which the structures have been examined in old spirit specimens, in which hardly any of the details are correctly preserved. E. W. B.

Arthropoda.

Insecta.

Observations on the Oogenesis of the Saw-Fly.—R. A. R. GRESSON ("Certain Phenomena of Tenthredinid Oogenesis as revealed mainly by Feulgen's Nuclear-Reaction," *Quart. J. Micr. Sc.*, 1930, **73**, 617–31, 1 pl., 4 text-figs.). Feulgen's "nuclealreaktion" shows clearly that visible chromatin is not extruded from the nuclei of nurse-cells, follicle-cells or oocytes; consequently chromatin plays no part in the nourishment of the egg, except when it is engulfed with the nurse-cell nuclei, nor do accessory nuclei occur in the saw-flies under consideration. A former conclusion that chromatin or accessory nuclei were extruded from nurse-cell, follicle-cell and oocyte, must therefore be withdrawn. G. M. F.

The Peritrophic Membrane in Insects.—V. B. WIGGLESWORTH ("The Formation of the Peritrophic Membrane in Insects, with Special Reference to the Larvæ of Mosquitoes," *Quart. J. Micr. Sc.*, 1930, **73**, 593–616, 10 text-figs.). In the larvæ of mosquitoes (Anopheles, Culex and Aedes) the secretion from the cells of the cardia, in the proventriculus, is drawn through an annular press and thereby moulded to form the peritrophic membrane. Probably, throughout the Diptera, the peritrophic membrane is formed by similar mechanisms. Analogous structures (a zone of secreting cells in connection with an annular press) have been found in most of the main orders of insects. In every case, in addition to its function as a press, the so-called "œsophageal valve" was found to act not as a valve, but as a sphincter. In the honey-bee (*Apis*) the larva of the dragon-fly (*Aeschna*) and possibly in other insects, indefinite membranes are shed off by the cells farther back in the mid-gut and added to those produced in the annular press. G. M. F.

Insects in Relation to Potato Virus Diseases.—K. M. SMITH ("Insects in Relation to Potato Virus Diseases," *Journ. of Ministry of Agriculture*, 1930, no. 3, 224–32, 4 pls.). During the last decade the attention of both plant and animal pathologists has been attracted by the steadily increasing importance of a group of diseases, of unknown cause, which are referred to loosely as "virus diseases." These disorders attack a wide range of plants and animals, not excluding man, and they exhibit a number of points in common, justifying their inclusion in a group by themselves. The author discusses the nature of virus diseases of plants, and how they differ from bacterial or fungal diseases, and gives an account of some potato virus diseases, the chief of which are "mosaic," "crinkle," "streak," and "leaf-drop streak" (Mosaic group), and leaf-roll, a disease considered an entirely different type. There are three main types of insect which attack the potato plant: (1) the green capsid bug; (2) the leaf-hopper, a small, active, black and yellow or pale green creature; and, lastly (3), the aphid or green fly. By the author's experiments it has been shown that only the last is able to transmit these diseases. The aphid referred to, known as *Myzus persicæ* Sulz., is a small green species, smaller than that usually found on roses. Like other aphids, it occurs in both winged and wingless forms, the winged form being green with black markings. It can be recognised by the shape of the "cornicles" or "siphons" on the back, which are swollen at the ends. The virus is transmitted from diseased to healthy plants by these aphids in the saliva excreted into the plant tissues when the insect "bites." This explanation is quite straightforward, so far as the "Mosaic" group of diseases is concerned, because it is known that these are transmissible by simple mechanical incision. It is not quite so clear, however, with leaf-roll, a disease which cannot be transmitted by simple incision or puncture, but is, nevertheless, very easily transmitted by *M. persicæ*. Here is a case where

there may be, possibly, some essential connection between the leaf-roll virus and its insect-carrier. It has been found that *M. persicae* which has been feeding for some days upon a potato plant affected with leaf-roll, if allowed to feed for two hours upon a healthy potato plant, will transmit the virus in that time, the plant developing symptoms, under glass-house conditions, 10 to 14 days later. Conversely, *M. persicae*, from a cabbage or some such immune and thus non-infective plant, will pick up the leaf-roll virus from a diseased potato plant in six hours. The whole process of infection of aphid and healthy plant, however, cannot be performed in eight hours. There seems to be a minimum period of about 54 hours before the non-infective aphids can become infective to a healthy plant. The investigator working upon virus diseases of the potato is seriously handicapped by the existence of certain varieties of potato which behave abnormally in their reactions to virus diseases, and which may be termed "carriers." These potatoes, although outwardly perfectly normal and healthy, nevertheless carry in their sap one or more potato viruses—that is to say, the virus exists in a quiescent yet infective condition within the "carrier" plant, which itself exhibits no disease symptoms. Recent work at Cambridge has revealed the existence of reservoirs of virus infection other than the potato itself. It has been found, for example, that the common solanaceous weed, black nightshade (*Solanum nigrum*), is not only infrequently infected with certain potato viruses, but is an almost perfect "carrier" of such viruses, exhibiting no symptoms other than a faint mottling of the leaves, which disappears with the continued growth of the plant. Experiment has proved that in this case at least the aphid can transmit infection from a "carrier" plant to healthy, susceptible varieties of potato. It is thought that one of the chief reasons for the comparative freedom of much Scottish seed from virus disease is the scarcity of the aphid "carrier" in that country. Therefore, if stocks of virus-free tubers could be raised in England under insect-free conditions, there seems little reason why they should not be equally as good as Scottish seed. From the author's article it will be realised that the potato virus problem is a complicated and important one, and that its solution is yet far to seek. M. E. M.

African Acrydiinae.—J. A. G. REHN ("Studies in African *Acrydiinae* (*Orthoptera*, *Acrididae*). Part 1, Sections: *Cladonotæ*, *Scelmenæ*, and *Metrodoraæ*," *Proc. of Acad. of Sciences of Philadelphia*, 1930, **82**, 91–137, 4 pls.). These studies are based on material from the collection of the late Dr. J. L. Hancock, and on collections sent in recent years to the author by various institutions. To this material has been added for study the collections of the British Museum, representing material from Sierra Leone, Liberia, Gold Coast, Nigeria, Abyssinia, Kenya, Tanganyika, Rhodesia, and Angola. The present study is based on approximately three-fourths of the species of the sections here considered known from the African mainland. Elsewhere in this work the author presents a study of the available Malagasy material of the sub-family, and it is stated that no close relationship exists between the genera there discussed and those here treated, the dissimilarity of the faunas being marked and apparently fundamental. Fifteen genera are here treated, of which 2 are described as new, while 29 species are discussed, 5 of them also being new. The continuation of this study, treating the remaining sections of the *Acrydiinae* as represented by available African material, will appear in the near future in the same journal. M. E. M.

Australian Oenochromidae.—A. J. TURNER ("Revision of Australian *Oenochromidae* (Lepidoptera), II," *Proc. of Linnean Soc. of N.S.W.*, 1930, **55**, pt. 2, no. 228, 1–40. The scope of this paper is indicated by its title. New species are described, and keys for the identification of the species are provided. M. E. M.

Australian Teleasinae.—A. P. DODD ("A Revision of the Australian *Teleasinae* (Hymenoptera : Proctotrypoidea)", *Proc. of Linnean Soc. of N.S.W.*, 1930, **55**, pt. 2, no. 228, 41-91). The sub-family *Teleasinae* of the family *Scelionidae* is rich in species, poor in genera. Kieffer (*Das Tierreich*, 1926) listed 230 species under 9 genera. The group is a compact one, and the numerous species are very similar in general outline. Little is known of their host associations. One North American species has been reared from the eggs of a Carabid beetle, and the group may be restricted to parasitism of Coleopterous eggs. In the experience of the author the Australian species are usually found in damp situations, either among the low shrubs and undergrowth of the coastal heavily-timbered country, or among grass growing near streams or swamps. They are particularly abundant during the wet season summer months in the mountain scrubs of Southern Queensland, where they can be collected in numbers, running over the surface of leaves within a few feet of the ground. On the other hand, they are not plentiful in the humid tropical jungles of North Queensland. The author indicates the chief characters of the sub-family and recognises among his material eight genera. The remainder of the paper consists of descriptions of the species, many of which are new.

M. E. M.

Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XXIII," *Proc. of Linnean Soc. of N.S.W.*, 1930, **55**, pt. 2, no. 228, 92-135, 30 text-figs.). The matter presented in this paper is to be considered as supplementary to that of the author's preceding paper in this series, in which he gave a partial revision of the *Tachinidae* of Australia, the material upon which it is based having been received from Dr. I. M. Mackerras some months after the completion of the earlier paper. The main part of this work is devoted to descriptions of species, many of which are new. Keys for the identification of the species dealt with are provided.

M. E. M.

Philippine Termites.—S. F. LIGHT ("Notes on Philippine Termites, IV," *Philippine Journ. of Science*, 1930, **42**, no. 1, 13-58, 8 pls., 1 text-fig.). Since the publication of the author's second note on the Philippine termites (1921) much time has been devoted to the study of his extensive collection from the archipelago, consisting of some 2,000 vials. The author takes account of our present knowledge of Philippine termites; describes species that represent genera new to the island, and others long described in manuscript, using the older method in order to make them available without long delay; makes certain corrections in previous work; and presents a working key to the genera of the archipelago and a list of the known species.

M. E. M.

Tipulidæ from Eastern Asia.—C. P. ALEXANDER ("New or Little-Known *Tipulidæ* from Eastern Asia (Diptera), VI," *Philippine Journ. of Science*, 1930, **42**, no. 1, 59-83, 2 pls.). The crane-flies discussed in the present paper are almost entirely confined to the extensive collections made by Prof. Syuti Issiki on Mount Kirishima, in Southern Kiushiu, Japan; in the rich native forest on the mountains of Yakushima Island, south of Kiushiu; and at Arisan and Chikurin, in the mountains of Formosa. A few additional species were taken in China (submitted by Prof. Jacot and Mr. H. S. Parish), and an interesting Tipulid was collected above 8,500 feet in the Japanese Alps, the highest altitude at which crane-flies have been recorded from the main island of Japan. Twenty-five new species are described.

M. E. M.

North American Haliplidæ.—J. R. HICKMAN ("Life-Histories of Michigan Haliplidæ (Coleoptera)," *Papers of Michigan Acad. of Science, Arts & Letters*, 1929, 11, 399-424, 9 pls.). The immature stages of the Haliplidæ of North America have received but little study. In fact, instars of only three species have hitherto been described. A general survey of the family was begun by the author in 1924, and has been continued until the present time. Primarily, the Michigan Haliplids, especially those occurring in the vicinity of Ann Arbor and the University of Michigan Biological Station at Douglas Lake, Michigan, have been studied. All the species known for Michigan have been reared by the author and the various stages examined in detail. Descriptions are given of the different instars for *Peltodytes lengi* Rbts., *Peltodytes semimaculatus* Rbts., *Peltodytes edentulus* Lec., *Haliphus immaculicollis* Harr., *Haliphus cribrarius* Lec., and *Haliphus triopsis* Say. Descriptions of the egg and first instar, however, are lacking for each of the last two species. The author provides an account of the mounting technique employed in the microscopical examination of these insects, and at the end of his paper gives a key for the identification of the immature stages of the Haliplidæ described. A short bibliography is also included.

M. E. M.

Rearing Dragon-Flies.—W. H. KRULL ("The Rearing of Dragon-Flies from Eggs," *Ann. of Ento. Soc. of America*, 1929, 22, no. 4, 651-8.) In working out the life-history of certain trematode parasites which occur as adults in vertebrate animals, it was necessary to rear parasite-free dragon-flies, which serve as an intermediate host in the life-history. Since parasitologists have to rear hosts which are free from certain kinds of parasites, it makes the problem of food and feeding more difficult. The literature on the subject of rearing common, well-known species of invertebrate animals in the laboratory is scarce, and, as there is an increasing demand for such knowledge, the author deems it worthy to record such information. The species of dragon-fly used in this work was *Sympetium obtrusum* Hagen. At the height of the season—the middle of August—eggs were collected by catching insects which were *in coitu*. In obtaining the eggs the female was grasped quickly by the wings, and if she had not already laid all of her eggs, they began to appear very shortly in pairs side by side at the genital opening. The eggs were collected by holding a dram vial containing clean tap water or swamp water underneath the insect. The eggs were kept in these uncorked vials for several days, transported to Ann Arbor, Michigan, and there they were transferred to Syracuse watch-glasses. Most of them were put into clean water, some into dishes containing mud and water, others into clean sand and water. The watch-glasses were covered to prevent evaporation. The eggs which were kept in clean water hatched the best. Eggs collected on August 14 and 15, 1928, began to hatch on October 9. Of 9 nymphs on which specific data were kept, 8 completed metamorphosis in 9 instars, and the remaining insect in 10. The average number of days between the eighth ecdysis and the transformation (8 specimens) was 21.5, the maximum number was 22.5, the minimum 18. Nymphs were reared on two kinds of food, but to do so was found to entail a great deal of time and effort. Nymphs were first fed on *Paramecium* and transferred to tubificid worms (Genus *Tubifex*) in the third instar. In feeding these very small nymphs the smallest worms have to be cut up and only the ends used in feeding. By adding *Cyclops* to the above foods an ideal combination is formed. A detailed description is given by the author of the means employed for feeding these insects.

M. E. M.

Sex Determination in Sciara.—C. W. METZ ("Sex Determination in *Sciara*," *The American Naturalist*, 1929, 63, 487-96). The author's conclusions

are as follows:—Sex determination (in the broad sense) involves two distinct series of phenomena: (a) determination of the sex of the progeny as a whole; (b) determination of the sex of the individual. Sex of the progeny is determined by the zygotic constitution of the female. Presumably female-producing females are *Aa*, male-producing females *aa*, and males *aa*, in constitution—*A* and *a*, representing either chromosomes or genes. Sex of the individual is determined in the ordinary fashion by a pair of sex chromosomes. *A* and *a* are probably “in” the X-chromosome or associated with it. “Unisexual” progenies are apparently the result of a selective elimination (inactivation) of sperms, not of zygotes. The “precocious” chromosome is probably not a sex chromosome. The “sex-limited” chromosomes are apparently not directly concerned in sex determination.

M. E. M.

New Species of *Apistomyia*.—A. L. TENNOIR (“Notes on the Genus *Apistomyia* (Diptera) and Description of a New Species,” *Proc. of Linnean Soc. of N.S.W.*, 1930, **55**, pt. 2, no. 228, 136–44, 14 text-figs.). The genus *Apistomyia* is one of the best characterised among the *Paltostominae*, especially on account of the peculiar shape of the simple radial sector, which is curved upwards in its distal part in such a way as to reach the costa very near the tip of R_2 , on account of its glassy wings with a dark apical spot in the females of most species, and the typical colouration of the abdomen with silver-grey transverse bands either complete or interrupted. Five species, including the one here described, are now known to belong to this genus, the distribution of which is a fairly wide one from the Mediterranean region, through the North of India to Malaya and to the east coast of Australia. The first species to be described, *A. elegans* Bigot, was discovered in Corsica, and, in spite of Bezzi’s prediction that it would be found also in Sardinia and on the Italian peninsula, Cyprus is, so far, the only other locality from which it has been recorded. The author gives a key for the identification of the adults of the species, and describes the male, pupa and larva of the new species, *Apistomyia mackerrasi*, n. sp.

M. E. M.

Australian Coleoptera.——J. H. CARTER (“Australian Coleoptera: Notes and New Species, VII,” *Proc. of Linnean Soc. of N.S.W.*, 1930, **55**, pt. 2, no. 228, 179–90, 1 pl., 1 text-fig.). Nineteen new species and one new variety are described

M. E. M.

New Plecoptera.——R. P. LONGIN NÁYÁS (“Entomologische Ergebnisse der Schwedischen Kamtschatka-expedition, 1920–1922. Plecoptera, 23,” *Archiv. für Zoologi*, 1930, **21**, 2, 1–8, 5 text-figs.). The new species described here are:—Fam. *Perlodides*, *Megarceys sjostedti* n. sp.; *Isogenus sibiricus* n. sp.; Fam. *Perlides*, *Chloroperla trapezia* n. sp.; Fam. *Capnides*, *Camnia apicalis* n. sp.; Fam. *Nemourides*, *Nuria* n. gen.; *Nuria frigida* n. sp.

M. E. M.

Braconidæ from the Kamtschatka Expedition.——J. FAHRINGER (“Entomologische Ergebnisse der Schwedischen Kamtschatka-expedition, 1920–1922. *Braconidæ*, 24,” *Archiv. für Zoologi*, 1930, **21**, 2, no. 8, 1–12). The description of several new species is included in this paper.

M. E. M.

New Sumatra Beetles.——M. PIC (“Dr. E. Mjöberg’s Zoological Collections from Sumatra. 10. *Dascillidæ* and *Malacodermata*,” *Archiv. für Zoologi*, 1930, **21**, 2, no. 9, 1–6). In a general account of the species included in this collection descriptions are given of several new species belonging to the families *Dascillidæ* and *Malacodermata*.

M. E. M.

Notes on *Phlebotomus nicnic* Banks.—C. MANALANG ("Notes on *Phlebotomus nicnic* Banks," *Philippine Journ. of Science*, 1930, **41**, no. 2, 169–72, 1 pl.). In view of uncertainty expressed by other writers on the systematic position of this species, the present study was undertaken with particular attention to the bucco-pharyngeal armatures and the genitalia. The results of the study seem to establish definitely that *P. nicnic* is a distinct species and not synonymous with *P. minutus*, *P. babu*, or *P. perturbans*. The author recounts his method of collecting the insects and the technique of his study, and gives a detailed description of the male and female of this species. M. E. M.

A New Species of *Phlebotomus*.—C. MANALANG ("A New Species of the Genus *Phlebotomus* Rondani," *Philippine Journ. of Science*, 1930, **41**, no. 2, 175–9, 1 pl.). The first specimen of this new species observed was an erect-haired male in a collection from one of the mosquito stations of the Novaliches water project. It was among a number of *Culicoides* collected in April, 1929. In the collection made in May, after some rains, the *Culicoides* were replaced by sandflies, mostly of the new species, and a few recumbent-haired species, *P. nicnic* Banks. Descriptions are given by the author of the male and female of the new species, *Phlebotomus philippinensis*. M. E. M.

Bucco-Pharyngeal Organs of Sphegidae.—E. BUGNION ("Les organes bucco-pharynges de deux sphegiens: *Sceliphron (Chalybion) bengalense* Dahlb. et *Sceliphron (Pelopoeus) spirifex* L.," *Mitt. Schweiz. Entom. Geselshft.*, 1929, **14**, 4, 139–70, 19 text-figs.). The author draws attention to the fact that there are several interesting organs connected with the mouth parts of certain Sphegid wasps which are at present almost unknown and practically unstudied—the pharyngeal pocket and the salivary ampoule, for example. These and other organs have been studied by the author in *Sceliphron (Chalybion) bengalense* and *Sceliphron (Pelopoeus) spirifex*. The results of the observations are contrasted with the condition found in *Ammophila sabulosa* at the end of the author's summary. M. E. M.

A bas le culte des Types.—E. STRAND ("A bas le culte des types!" *Lambilliona*, 1929, no. 2, 23–6). The author declaims against the importance given to "types" and "type-descriptions" in biological literature, and advances valid reasons for his views in that many of the specimen "types" are no longer existent, and therefore cannot be verified, and that often the "type-descriptions" are inaccurate. M. E. M.

Arthropoda.

Arachnida.

Tasmanian Spiders.—V. V. HICKMAN ("Studies in Tasmanian Spiders, Part IV," *Papers & Proc. of Roy. Soc. of Tasmania*, 1929, 87–122, 7 pls., 19 text-figs.). The present paper deals with five new species of spiders, one of which forms the type of a new genus in the *Oonopidae*. The scheme of classification proposed by Prof. A. Petrunkevitch, of Yale University, in his *Systema Araneorum* (1) is adopted. The names of the new spiders are:—*Aname peza* sp. nov.; *Tasmanoomops alipes* sp. nov.; *Miturga albopunctata* sp. nov.; *Miturga splendens* sp. nov.; *Miturga velox* sp. nov. M. E. M.

Philippine Water-Mites.—VON C. WALTER ("Hydracarinen von der Insel Lozon, Philippinen," *Philippine Journ. of Science*, 1930, **41**, 2, 159–66, 3 text-figs.). The author gives descriptions of the following new species from the island

of Luzon :—*Limnesia bakeri* n. sp.; *Neumania ambigua* n. sp.; *Neumania flagellata* n. sp. M. E. M.

Hydracarina of the Isle of Bornholm.—O. LUNDBLAD ("Die Hydracarinen der Insel Bornholm," *Det. Kgl. Danske Videnskabernes Selskab., Biologiske Meddelelser*, 1930, 8, no. 7, 1–96, 9 pls., 1 text-fig.). The collection here dealt with was made in 1926 on the Isle of Bornholm in the Baltic. Dr. Lundblad describes, and in many cases figures, about 44 species in all. No new species are added to those already known, but there is one new variety—*Lebertia stigmatifera separata* Lundblad.

C. D. S.

Nemathelminthes.

Nematoda.

New Technique for Collecting Intestinal Roundworms.—JAMES E. ACKERT and L. O. NOLF (*Science*, 1929, 70, no. 1813, 310–11). Experiments were made with the larva of *Ascaridea lineata* in chickens. The experimental animal was starved overnight or 6 hours prior to autopsy. It was then killed, and the small intestine quickly removed and divided into portions of about a foot in length. Each portion was then flushed (by means of a flushing cone) with hot water under pressure, in order to remove the intestinal contents before the mucous glands had time to secrete. The temperature of the water should be between 60° and 35° C., and the pressure sufficient to distend the intestine (so enlarging the spaces between the villi) without rupturing it. The material obtained, after being preserved with 4 p.c. formol, was decanted and then stained with Jenner's stain, and examined with low-power binoculars, when the worms (which remained unstained) could be clearly seen against the blue intestinal debris. Scraping of the mucosa after flushing did not reveal the presence of a single worm, and the technique was found to be as successful with large as with small worms.

J. L.

Studies on Japanese Amphistomatous Parasites, with Revision of the Group.—T. FUKUI (*Jap. Journ. Zool.*, 1929, 2, 219–351). Fourteen species are described and figured, one of which is new. A detailed study has also been made of the anatomy and histology of the *Amphistomata*, and this is profusely illustrated by means of diagrams and microphotographs. The author reviews the history of the classification of the group, and submits a revised classification with keys to families, subfamilies, tribes, genera, subgenera and species, and the study concludes with a list of the hitherto described species of *Amphistomata*, together with their hosts, habitats, and localities.

J. L.

On the Incidence and Degree of Infestation with Hookworm and *Trichostrongylus orientalis* in Keijo.—HARUJIRO KOBAYASHI, EIICHI CHIBA, and TOSHIO FURUYAMA (*Acta Med. Keijo*, 1929, 12, 66–71). Examination of the fæces of 1,389 school-children by the smear method revealed a very heavy infestation with *Ascaris lumbricoides* and *Trichocephalus trichiura*, and a relatively lower percentage of hookworm and *Trichostrongylus orientalis*. By culturing, however, the incidence of these latter species was remarkably increased. A relatively high percentage of hookworm infestation was found in adults by the smear method. The incidence of *Trichostrongylus orientalis* in adults, as gauged by the culture method, appeared to be about half that of the hookworm. *Ascaris lumbricoides* and *Trichocephalus trichiura* were very common in all cases, especially *Ascaris* in children.

J. L.

Two Nematode Parasites of the Guillemot.—K. MORISHITA (*Jap. Journ. Zool.*, 1930, 3, 67–72, 4 text-figs.). A rare nematode, *Eustrongylus ignotus* Jägerskiöld, 1907, is here reported in the Eastern hemisphere for the first time. The parasites were found partly embedded in the wall of the fore-stomach of the guillemot, with head and tail projecting, the position of the worms being marked by swellings or nodules. *Cosmocephalus imperialis* n. sp., which was found free in the lumen of the fore-stomach of the same host, is also described and figured.

J. L.

Platyhelminthes.

Trematoda.

An Analysis of the Methods used in the Study of Larval Trematodes.—H. W. STUNKARD (*Parasitol.*, 1930, 22, 268–73). The advantages and difficulties of various methods employed in the study of larval trematodes are discussed. The desirability of using living specimens rather than fixed material, and of studying mature normally emerged cercariæ rather than those obtained by crushing the host, is noted. Intra-vitam staining with neutral red is recommended to demonstrate the form and reaction of the secretory granules in gland cells. Knowledge of the details of the excretory system is of major importance in both theoretical and experimental work.

G. M. F.

Life-History Studies on the Trematode Family Bucephalidæ. No. 2.—ARTHUR E. WOODHEAD (*Trans. Am. Micr. Soc.*, 1930, 49, 1–17, 2 pls.). All stages in the life-history of *Bucephalus elegans* n. sp. are described and illustrated. The first intermediate host is a small mussel, *Erynia iris*, about 6 p.c. of which are infected in the Huron River. Development is completed in the rock bass. *Bucephalus pusillus* is redescribed, and the *Miracidia* reported for the first time.

J. L.

Two New Helminths: Parasites of *Uraeotyphlus oxyurus* (Gray), *Gymnophiona* from Central India.—JEAN-G. BAER ("Deux helminthes nouveaux, parasites de *Uraeotyphlus oxyurus* (Gray), gymnophione de l'Inde méridionale," *Rev. Suisse de Zool.*, 1930, 37, 43–52, 5 text-figs.). The material was obtained from *Gymnophiones* captured in the Palni Hills. *Gordodera carli* n. sp., from the urinary bladder of *Uraeotyphlus oxyurus*, is first described, and is the first record of a trematode parasitic in a footless amphibian. It is also apparently the first representative of the genus to be recorded from Asia. A new species of *Rhabdias*, *R. escheri*, was also obtained from the body cavity of the same host, in which it is recorded for the first time in India.

J. L.

Brief Notes on New Trematodes, 3.—S. GOTO and Y. OZAKI (*Jap. Journ. Zool.*, 1930, 3, 73–82, 7 text-figs.). The authors describe and illustrate a new genus and species, *Phocitrema fusiforme*, from a seal, together with three new species of *Mesocœlium* and one of *Lebouria*.

J. L.

Helminthological Research in Hamburg. 1. The Genus *Haplometra* Looss, 1889.—L. TRAVASSOS ("Pesquisas helminthologicas realizadas em Hamburgo. 1. Genero *Haplometra* Looss, 1889," *Mem. Inst. Oswaldo Cruz*, 1930, 23, 163–8, 11 pls.). A detailed study of the single species in this genus, *Haplometra cylindræa*, from *Rana temporaria*, has been made. It is shown to be prone to considerable variations within the species, which the author describes and illustrates, and shows to be reducible to three types.

J. L.

Helminthological Research in Hamburg. 2. On Two Trematode Parasites of Mammals.—L. TRAVASSOS and E. VOGELSANG ("Pesquisas helminthologicas realizadas em Hamburgo. II. Sobre dois trematodeos parasitos de mamiferos," *Mem. Inst. Oswaldo Cruz*, 1930, **23**, 169–71, 1 pl.). A new species of *Hippocrepis*, from the intestine of *Myopotamus capys*, is described and figured, together with a figure of the type species. A species of *Gastrodiscus*, apparently *G. secundus*, was recovered from the faeces of an Indian elephant. Identification was somewhat tentative, as all the specimens were immature, and a table is given of the various measurements. J. L.

Contribution to the Origin of Unisexuality in the Genus *Dioicocestus* (Fuhrm).—W. CLERK ("Quelques données sur l'origine de l'unisexualité dans le genre *Dioicocestus* (Fuhrm)," *Rev. Suisse de Zool.*, 1930, **37**, 147–71, 13 text-figs.). Numerous specimens of *Dioicocestus aspera* were obtained from the grebe, *Podiceps griseigena*. This, it appeared, was the true host, for in *P. cristatus* and *P. auritus* only males developed completely. Between the normal males and females were found to exist a whole series of transitional forms showing retarded general development and incomplete differentiation of the sexual organs. The males without testes were to be regarded as true intersexes, the incomplete strobilae as intersexes with predominance of the male or female characters. The degree of infestation varied considerably. Females were more numerous than males, and incomplete development was also more frequent in them. The presence of normal couples of *D. aspera* in *P. griseigena* in spring was the result of the survival of the best adapted individuals capable of forming sexual organs. J. L.

Protozoa.

Selection and Susceptibility to Bird Malaria.—C. G. HUFF ("The Effects of Selection upon Susceptibility to Bird Malaria in *Culex pipiens* Linn.," *Ann. Trop. Med. & Parasitol.*, 1929, **23**, 427–42, 2 pls., 2 text-figs.). This paper is a study of parasitism from the biological standpoint only, and aims at explaining the cause and nature of specificity. For the details of technique employed the paper must be consulted in the original. The work has produced evidence that there probably exist susceptible and non-susceptible races of *Culex pipiens* as regards *Plasmodium cathemerium*. Selection of progenies from infected mothers caused the number of infected individuals in a particular line to increase rapidly in percentage. Selection from uninfected mothers caused a rapid decrease in the percentage of infected individuals in such a line. G. M. F.

Coccidiosis in Gallinaceous Birds.—E. E. TYZZER (*Am. J. Hyg.*, 1929, **10**, 269–383, 9 pls., 2 text-figs.). A review of the literature reveals the fact that *Eimeria avium* is not a valid species, and that *E. tenella*, Railliet and Lucet, causes disease of the caeca. Three new species of eimeria from the chicken are described and named *E. mitis*, *E. acervalina* and *E. maxima*. The chicken also sometimes harbours a coccidium of the genus *Cryptosporidium*. The turkey has two species of coccidium, *E. meleagridis* and *E. meleagrimitis*. The pheasant also harbours two species, *E. phasiani* and *E. dispersa*. The factors necessary for differentiation are given. G. M. F.

The Sarcosporidia.—J. W. SCOTT ("The Sarcosporidia: A Critical Review," *J. Parasitol.*, 1930, **16**, 111–30). This is a useful review of the work that has been done on the Sarcosporidia. Questions of morphology and development,

life-history and host-parasite relationship, are discussed in a critical manner, and a summary of the present position of these protozoa and of the problems awaiting solution is given.

C. A. H.

A Flagellate of the Green-Bottle Fly.—R. W. GLASER ("A New Flagellate from the Intestine of *Lucilia cæsar* L.," *J. Parasitol.*, 1930, **16**, 137-9). Description of a new flagellate found in the intestine of *Lucilia cæsar*. The flagellate appears to belong to the Monadidæ, but its exact systematic position is uncertain, and no name is given to it. It has an elongated rounded body, with two flagella, two blepharoplasts, one parabasal, and one or two food vacuoles, which may contain bacteria, though no cytostome was observed. The average measurements of the flagellate are 7.76μ by 4.6μ .

C. A. H.

Effect of Starvation on Termite-Flagellates.—M. YAMASAKI ("Studies on the Intestinal Protozoa of Termites. I. Starvation Experiments on the Commonest Japanese Termite, *Leucotermes speratus*," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1930, **5**, 19-26, 8 charts). Experiments were carried out with the termite *Leucotermes speratus* with the object of ascertaining the effect its starvation has upon the duration of life of its intestinal flagellates. Workers from seven termite colonies were deprived of food and examined for parasites every 24 hours. The conclusion arrived at is that the duration of life in the flagellates of starved termites seems to be a function of temperature. The lower the temperature falls, the longer the protozoa live.

C. A. H.

Morphology of Streblomastix.—G. W. KIDDER ("*Streblomastix strix*, Morphology and Mitosis," *Univ. Calif. Pub. Zool.*, 1929, **33**, 109-24, 2 pls., 3 text-figs.). *Streblomastix strix* is a flagellate of the family Streblomastigidæ, order Polymastigida. It is parasitic in the termite *Termopsis angusticollis*, and is found attached to the gut wall by a cup-like organ at the tip of a rostellum. Its body is spindle-shaped, measuring on the average $45 \times 10\mu$. There are four free, undifferentiated, anterior flagella, 4-8 ridges wound around the body leiotropically, myoneme bands, one nucleus and an organ of attachment. There is no cytostome, nourishment being taken by absorption. Multiplication is by binary fission, the nucleus dividing mitotically.

C. A. H.

Thermotaxis in Euglena.—E. De WILDEMAN ("A propos du thermotaxisme des euglènes," *Ann. Protistol.*, 1928, **1**, 127-36.) Experiments were conducted on the reactions of *Euglena viridis* to various thermal stimuli. In one series of experiments ordinary glass tubes were employed. In some of these, in order to avoid convection currents, the fluid containing the flagellates was mixed with sand, while in others the fluid was used alone. In another series capillary tubes with a central bulb and containing the fluid with euglenas were employed. In the first set the tubes were either kept in the dark or exposed to the light, and were placed in a horizontal position with one end directed towards the source of heat. The temperature at one end of the tubes ranged from 16° to 22° C., and from 23° to 35° at the warmed end. The flagellates always migrated to the warmer part of the tube. In the experiments with capillary tubes the results were similar when conducted in the dark. However, when the tubes were exposed to light falling perpendicularly to their long axis, the flagellates accumulated at the illuminated part, independently of its relative temperature. It thus appears that the heliotropic attraction is stronger than the thermotactic attraction.

C. A. H.

The Structure of Peridinium.—M. LEFÈVRE ("Notes sur le *Peridinium cunningtonii* Lemm. et sur quelques formes affines," *Ann. Protistol.*, 1928, 1, 119–26, 50 text-figs.). A comparative morphological study of several species of the genus *Peridinium*, with special reference to *P. cunningtonii*. C. A. H.

The Flagella of the Peridinians.—G. ENTZ, jun. ("Über den Bau und über die Tätigkeit der Geisseln der Peridineen," *Ann. Protistol.*, 1928, 1, 75–95, 29 text-figs.). An investigation on the structure and function of the flagella in the Dinoflagellata. *Gonyaulax polygramma*, which was studied in greater detail, is provided with a centrosphere lying near the nucleus. At the base of the flagella there are fairly large basal bodies. Both flagella originate as cylindrical filaments of equal length, but later the spiral flagellum becomes band-shaped. It is composed of a fibrillar axis surrounded by a sheath in the form of an undulating membrane. The plasmatic portion of the flagellum is capable of amoeboid changes of shape. The movement of the spiral flagellum is effected as follows: at first its axial filament breaks up into separate rods, then the rods approach and overlap each other, forming folds on the surface of the flagellum. These changes begin at the base and gradually extend to the tip of the flagellum, causing an undulating movement of the whole. The free flagellum moves by contracting itself into a spiral and then relaxing. C. A. H.

The Genus Nyctotherus.—P. P. GRASSÉ ("Sur quelques *Nyctotherus* (Infusoires hétérotriches) nouveaux ou peu connus," *Ann. Protistol.*, 1928, 1, 55–68, 1 pl., 4 text-figs.). A systematic description is given of some species of *Nyctotherus*, new and known, together with an account of their life-cycle. The following forms are dealt with:—*N. haranti* Grassé, 1926 (hitherto undescribed) from the gecko, *Tarentola mauritanica*; *N. tipulæ* n. sp. from a tipulid, *Ctenophora elegans*; *N. duboisi* Kunstler, 1884, from the larvæ of the beetle *Cetonia aurata*; *N. velox* Leidy, 1849, from *Spirostreptus* sp.; *N. gyrogyanus* (Clap. and Lachm., 1858) from *Hydrous pistaceus*. It is proposed to divide the genus *Nyctotherus* into two subgenera: *Nyctotherus*, with *N. velox* for type, provided with a caryophore, and *Nyctotheroides* with type *N. cordiformis*, in which this structure is absent. The caryophore in *Nyctotherus* appears to be composed of separate fibrils connecting the macro-nucleus with the body-wall. Conjugation, which is anisogamous, was observed only in *N. cordiformis*, and is similar to the process in other Heterotrichida. C. A. H.

The Muciferous Apparatus and the Vacuome in Euglenas.—P. DANGEARD ("L'appareil mucifère et le vacuome chez les Euglènes," *Ann. Protistol.*, 1928, 1, 69–74, 3 text-figs.). This paper is devoted to a study of the muciferous apparatus and the vacuome in *Euglena*. With regard to the degree of development of these organellæ, the flagellates can be divided into two groups. In one (*E. deses*, *E. acus*, *E. tripteris*) division takes place in the motile stage and no mucus is produced. In the other (*E. viridis*, *E. velata*, *E. sanguinea*) the flagellates round off before division (resting stage) and secrete mucus which surrounds them in the form of a membrane. A muciferous apparatus is either absent or slightly developed in members of the first group, but is highly developed in those of the second group. A vacuome in the form of a system of minute vacuoles scattered through the cytoplasm is present in all euglenas. These vacuoles are disposed in the deeper part of the cytoplasm and do not communicate with the exterior. The muciferous apparatus consists of a system of "pockets" arranged on the periphery of the body and opening on the surface by minute pores through which the mucus is extruded. Both the muciferous apparatus and the vacuome

take up neutral red, but the latter, being more deeply situated, stains later. The two apparatus also differ in that the vacuome has an alkaline reaction, while the particles of mucus are acid. Apart from this, the muciferous apparatus, being in communication with the outside medium, can be stained *post mortem*, while the vacuome only stains during the life of the organism. C. A. H.

A New Species of Ciliate from the Intestine of Earthworms.—C. CONKLIN (" *Anoplophrya marylandensis* n. sp., a Ciliate from the Intestine of Earthworms of the family Lumbricidæ," *Biol. Bull.*, 1930, **58**, 176-81, 5 text-figs.). This new species of astomatous ciliate was discovered in the intestine of *Lumbricus terrestris* Linn. 1758 and *Helodrilus calignosus* Savigny 1826, from a limited area in the city of Baltimore. It is uniformly ciliated and flattened, rounded at the posterior end and slightly pointed at the anterior end. There are two nuclei, a large ribbon-like macronucleus and a small spherical micronucleus. Division was transverse, while there was a single longitudinal row of contractile vacuoles along one side of the macronucleus. The number varied from two to five. G. M. F.

Californian Foraminifera.—J. A. CUSHMAN and W. W. VALENTINE ("Shallow-water Foraminifera from the Channel Islands of Southern California," *Cont. Dept. Geology, Stanford University*, 1930, **1**, no. 1, 1-51, 10 pls., 1 map). The islands lie between 20 and 50 miles off the Southern Californian coast, in latitude 33°-34° N., and the material taken in depths 3-20 fathoms has all the characters of shallow-water deposits in the warm temperate zone. It was found that the foraminifera from similar environments at different localities were uniform, but there was some evidence of an ecological distribution, e.g., in the same bay Miliolidæ were plentiful on one side, but nearly absent on the other. The fauna as a whole is related to that on the West Coast of South America, but some species are derived from colder regions, and are related to North European forms. Many of the species occur in the later tertiaries of California. One new genus, *Dyocibicides*, and 13 new species are described. The paper is lavishly illustrated, and the figures are good. A. E.

New Jurassic Foraminifera.—J. A. CUSHMAN ("Note sur quelques Foraminifères jurassiques d'Auberville (Calvados)," *Bull. Soc. Linnéenne de Normandie*, 1929, ser. 8, **2**, 132-5, 1 pl.). On the shell of a Jurassic mollusc from the zone of *Cardioceras cordatum* at Auberville, which was in the Defrance collection at Caen University, a sessile foraminifer was observed. An examination has shown that it represents a new genus, *Nubeculinella*, of the family Ophthalmitidæ, akin to *Nubecularia* Defrance, from which it appears to differ only in the possession of a straight series of chambers. *Nubeculinella* is stated to be very abundant on fossils at the type locality, and the author has also collected it from the lias of Banbury and Oxford. The matrix attached to the original fossil also yielded other foraminifera, including a new species of *Haplophragmoides*. A. E.

Californian Tertiary Foraminifera.—J. A. CUSHMAN and R. E. and K. C. STEWART ("Tertiary Foraminifera from Humboldt County, California. A Preliminary Survey of the Fauna," *Trans. San Diego Soc. Nat. Hist.*, 1930, **6**, no. 2, 41-94, 8 pls., 1 chart). This is stated to be a preliminary survey preparatory to an inclusive study of the local Tertiary foraminifera. In Humboldt County the tertiary is represented by scattered patches lying in troughs formed by folding and faulting of beds not younger than Cretaceous. Samples were examined from 48 localities, and the chart shows the distribution of the recorded species. Five of the stations are regarded as of undoubted Miocene age, the others (with three

exceptions) being Pliocene. Separate lists are given of the species confined to the Pliocene and Miocene respectively. There are several new species, and the paper is well illustrated. A. E.

On *Sagrina* (?) *tesselata* Brady.—J. A. CUSHMAN ("The Development and Generic Position of *Sagrina* (?) *tesselata* H. B. Brady," *Journ. Washington Acad. Sciences*, 1929, 19, no. 15, 337–9, fig. in text). This obscure organism was described from "Challenger" material from the Admiralty Islands and Torres Straits, and there are subsequent records from Eastern seas and Tertiary deposits. Millett, in his Malay papers, announced the subdivision of the chambers into chamberlets, and suggested its transference to a new genus, for which Schubert proposed the name *Millettia*. This name being preoccupied, A. Silvestri has used *Schubertia* in its place. The type specimens in the Brady collection are megalospheric, and give no clue to the early development of the species. The author now figures some specimens from the Philippine Islands which are believed to be microspheric. The early chambers are apparently biserial, slightly twisted, and undivided into chamberlets. *Schubertia* is probably derived from *Siphogenerina*, and has existed in its present area, the Indo-Pacific region, at least since early Tertiary times. A. E.

East Texas Greensands.—J. A. CUSHMAN and NORMAN L. THOMAS ("Common Foraminifera of the East Texas Greensands," *Journ. Paleont.*, 1930, 4, no. 1, 33–41, 2 pls.). The weathering of the greensands is very deep and destructive to fossils. Nine species are described and figured, three of which are new. A. E.

Atlantic Foraminifera.—J. A. CUSHMAN ("The Foraminifera of the Atlantic Ocean.—Nonionidæ, Camerinidæ, Peneroplidæ and Alveolinellidæ," *Smithsonian Instit., U.S. Nat. Museum*, Bull. 104, pt. 7, 1930, 1–79, 18 pls.). Of the families dealt with in this monograph, the Nonionidæ are represented in the Atlantic by three genera only, but these have numerous species, often abundant in shallow water; the Camerinidæ, so abundant in the Indo-Pacific region, are almost absent; while the Peneroplidæ and Alveolinellidæ are represented by simpler and more primitive types than in the Indo-Pacific, though a few of the species are very abundant in the West Indies. The latest American views on classification and nomenclature are followed. As a result, the student will look in vain for many names which have become almost household words—e.g., *Polystomella crispa* (Linn.) is probably the commonest, as it is the handsomest of all British foraminifera. Here it must be looked for under *Elphidium crispum* (Linnaeus), only to find a short note to the effect that numerous authors have recorded *Polystomella crispa* from the Eastern Atlantic—Williamson in 1858 figured specimens "which are reproduced here"—(*They are not.*—A. E.)—they are not the same as the Mediterranean types, and they are left for a more intensive study of the genus now under way. But surely it is not right that a monograph which purports to cover the Atlantic Ocean should dismiss a common and generally accepted species in this manner and without even a figure. This is the kind of specialism which is rapidly reducing zoology to the level of stamp-collecting, and making the way of the beginner as hard as that of the transgressor. Many old names are revived, but only one species and two varieties are described as new. The illustrations are good. A. E.

Upper Cretaceous Foraminifera.—W. BERRY and L. KELLEY ("The Foraminifera of the Ripley Formation on Coon Creek, Tennessee," *Proc. U.S. Nat. Mus.*, 1930, no. 2816, 1–20, pls. 1–3). The material is from the zone of *Erogyra*

costata, and the foraminifera are extremely well preserved, looking more like late Tertiary than Upper Cretaceous specimens. Thirty-seven species and varieties belonging to 19 genera are described, all inhabitants of shallow water. Nineteen of the species and varieties are described as new. The figures are somewhat crude.

A. E.

Ancestry of Hantkenina.—J. A. CUSHMAN and R. T. D. WICKENDEN ("The Development of *Hantkenina* in the Cretaceous, with a Description of a New Species," *Cont. Cushman Lab. Foram. Res.*, 1930, no. 91, 39–43, 1 pl.). The Eocene fossil figured and described by Hantken as *Siderolina Kochi* is known to belong to the genus *Hantkenina*, but the nature of *Siderolina cenomana* Schacko has for long remained a problem. Through the discovery of similar specimens in the Cretaceous of Southern Manitoba, it has now been possible to make a detailed study of Schacko's species. This is very small, but has a very similar early development to Hantken's species, though in some respects more primitive. There are four chambers in each coil, as against three in *H. Kochi*, and the final chamber of *H. cenomana* loses its tubular extension and becomes more or less globular. There is a description of *H. cenomana* Schacko, with reproductions of the original figures, and figures and description of a new and closely allied form, *H. multispinata*, from the "chalk" of Manitoba, which appears to be contemporaneous with the Taylor formation of Texas.

A. E.

Australian Tertiary Foraminifera.—F. CHAPMAN and IRENE CRESPIN ("Rare Foraminifera from Deep Borings in the Victorian Tertiaries—*Victoriella*, gen. nov., *Cyclocypeus communis* Martin, and *Lepidocyclina borneensis* Provale," *Proc. Roy. Soc., Victoria*, 1930, 42 (N.S.), pt. 2, 110–15, 2 pls.). The new genus *Victoriella* was originally described by the senior author in 1922 under the name *Carpenteria proteiformis* var. *plecte*; it is now made the type for a new family, Victoriellidae, which is allied to the Rupertiidae, but separated from that family by its persistently non-adherent mode of life, by the absence of a definite spiral arrangement of the chambers, and by its aperture, which is more or less slit-shaped without tendency to form a tubular neck, as in *Carpenteria* and allied forms. *Victoriella* occurs only in the basal Janjukian, and is likely to be of value as a zonal indicator. The distribution of the other species named in the title is given, and there are figures of all the forms.

A. E.

Faroeese Foraminifera.—J. HOFKER ("Foraminifera," reprinted from *The Zoology of the Faroes*, 1930, Copenhagen, 21 pp, 33 text-figs.). There was originally no intention of including Protozoa in "The Zoology of the Faroes," and no special collecting was done. The paper deals with nine cosmopolitan species only, of which specimens were found in samples of other material. The localities are confined to the coastal waters, the Faroe shelf and Faroe Bank only. No sporulation was detected in *Miliolina seminulum*, which was observed to feed on diatoms, which were sometimes so numerous in the final chamber as to give little room for the protoplasm. Many diatoms were also found in the protoplasm of the inner chambers also. Those in the outer chambers were very distinct, owing to their high refractive index, but those in the inner chambers were scarcely visible, probably because the siliceous shells had been absorbed. There is an interesting study of the fistulose outgrowths of *Polymorphina acuta*, which were studied in sections of a decalcified specimen, and the conclusion was formed that these outgrowths are due to changes in the protoplasm prior to sporulation. *Truncatulina lobatula* is dealt with at some length, and its numerous variations are shown to be due to Trimorphism.

A. E.

Freshwater Rhizopoda from Faroes.—J. HOFKER ("‘*Amœbidu Testacea*,’ reprinted from *The Zoology of the Faroes*,” 1930, Copenhagen, 8 pp., 3 text-figs.). No previous studies of freshwater rhizopoda from the Faroe Islands have been published, but some preserved material in the Zoological Museum at Copenhagen yielded nine species, all cosmopolitan, which are briefly dealt with. Only one locality yielded abundant specimens; the others contained but few, and mostly belonging to a single species. This is curious, as small lakes with mosses are common in the country. The limited fauna may be due to the isolated position of the Faroes. A. E.

Upper Cretaceous Foraminifera.—J. A. CUSHMAN ("Notes on Upper Cretaceous Species of *Vaginulina*, *Flabellina*, and *Frondicularia* from Texas and Arkansas,” *Cont. Cushman Lab. Foram. Res.*, 1930, no. 90, 25–38, 2 pls.). The Upper Cretaceous deposits of Texas and Arkansas are rich in species of these genera. Most of the species are widely distributed in both hemispheres, but have rather restricted vertical ranges, and thus form excellent markers of horizons. It is impossible to work the American material intelligently without a careful study of the literature of European species and an examination of European material. Twenty-four different forms are described, including two new species of *Vaginulina* and two new varieties of *Frondicularia*, and the paper is admirably illustrated. A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Meiosis in Hybrids of *Aegilops*.—J. PERCIVAL ("Cytological Studies of Some Hybrids of *Aegilops* sp. \times *Wheats*, and of Some Hybrids Between Different Species of *Aegilops*," *Journ. Genetics*, 1930, **22**, 201-78). Thirty-three hybrids of *Aegilops ovata*, *Ae. cylindrica*, *A. triuncialis* and *A. ventricosa*, crossed with different wheats and with each other, have been studied, and the details of their meiotic divisions are described. The general cytological features of the two types of hybrids are similar. In the *Aegilops* \times *wheat* hybrids the diploid number of univalents is often seen on the heterotypic spindle, but in most cases there are from 1-7 bivalents. The bivalents are of two kinds: (a) telosyndetic, in which the components are joined end to end, and (b) parasyndetic, in which they lie side by side after first being joined end to end. It is suggested that parasyndetic bivalents are only formed when exactly homologous univalents meet, the telosyndetic type arising when the conjugating chromosomes are not so closely related. Still more distant relationship is indicated by non-pairing of univalents. Results indicate that seven chromosomes in the bread wheats have been derived from *A. cylindrica*. The number of chromosomes which pass to the poles in these hybrids is very variable, both in heterotypic and homotypic division. The hybrid *A. ovata* \times *Triticum turgidum* var. *iodurum* is fertile. In the F_1 plant there are 28 univalents in the pollen mother-cells. In the F_2 plant there are 58 univalents, suggesting that diploid gametes are produced by the F_1 . All the *Aegilops* species hybrids are sterile. Parasyndetic bivalents are of more frequent occurrence than in the *Aegilops* \times *wheat* hybrids. The bivalents separate normally, and there is a greater tendency for equal numbers of chromosomes to pass to the poles than in the *Aegilops* \times *wheat* hybrids. J. L.

Chromosome Association in *Pyrus*.—C. D. DARLINGTON and A. A. MOFFETT ("Primary and Secondary Chromosome Balance in *Pyrus*," *tom. cit.*, 129-51.) The basic chromosome number in *Pyrus* is 17. Orthoploidy is exhibited by all cultivated varieties. A long chromosome is represented four times in the somatic complement in "diploid" *Pyrus*, and six times in "triploid." The chromosomes of the "diploid" show multiple association, and in extreme cases only seven groups are present—four quadrivalents and three sexivalents. Trivalents are usually formed in the "triploid" varieties of *P. Malus*, therefore autosyndesis takes place within each of the three supposed haploid complements. Multiple associations have also been observed. Breeding results, together with the pairing and morphology of chromosomes, show that the 34 chromosomes in "diploid" *Pyrus* are of seven types, four being represented four times, and three represented six times. The number 17 is therefore a secondary (unbalanced) basic number,

and the derived series of polyploids are secondary polyploids. The special morphological characters of the *Pyrus* group may be due to this establishment of a secondary basic number, i.e., to this reorganisation of the nucleus. J. L.

Fertility and Chromosome Number in Apples.—M. B. CRANE and W. J. C. LAWRENCE ("Fertility and Vigour of Apples in Relation to Chromosome Number," *tom. cit.*, 153–63). In general, odd multiple polyploids are relatively infertile. In *Prunus* and *Rubus*, where development of the drupes is largely dependent on the development of the seed, the odd multiple forms are relatively unproductive. In *Pyrus*, however, the triploid forms are fruitful enough to be of economic importance. In apples a very low proportion of fruit to flowers is sufficient to give a crop. Ten embryos are present in the apple, and a single seed is sufficient for the development of a fruit, and even this seed may be imperfect. Apples may therefore produce fruit in spite of a high degree of generational sterility. Offspring of triploids, either selfed or crossed with diploids, are of little value, lacking vigour and fertility. This is presumably due to their aneuploid constitution. J. L.

X-rays on Seedlings.—S. B. WIGODER and R. PATTEY ("Some Effects of Röntgen Rays on Seedlings," *Proc. Roy. Irish Acad.*, 1929, 39, B., 146–55). Seedlings of *Vicia Faba*, Barley and White Mustard were subjected to X-radiation. Full details of the experimental methods are given. Dry seeds are completely resistant to X-rays. When germinating seeds are irradiated, some stunting of growth results, the amount varying according to the length of time the seed has been growing. In no case is a stimulating effect observed. The first change brought about is the cessation of mitosis. Three hours after irradiation very few stages of cell division are seen. Cells which were dividing during the period of exposure are unable to complete the process, and present abnormal appearances. Three days after irradiation practically no dividing cells are seen, while from five to eight days after exposure some dividing cells are present, many being abnormal. Binucleate and multinucleate cells are also a very characteristic feature. J. L.

Meiosis in Lathyrus.—T. MAEDA ("The Meiotic Divisions in Pollen Mother-Cells of the Sweet Pea (*Lathyrus odoratus* L.), with Special Reference to the Cytological Basis of Crossing-over," *Mem. Coll. Sci., Kyoto Imp. Univ.*, 1930, 5, B., 89–123). The 14 somatic chromosomes can be divided into two classes: two pairs with three constrictions and five pairs with two constrictions. The meiotic divisions are described in detail. There is no constant connection between the nucleolus and spireme threads. The method of pairing is parasyndetic. From late synizesis up to metaphase the double nature of the spireme threads is observed. These threads lie parallel two by two with crossing points at certain intervals. There is no stage which corresponds to the "brochonema" previously described in *Lathyrus*. The configuration of the bivalents is described at length, together with the disjunction of their component chromosomes and the longitudinal splitting of these univalents in anaphase. On the cytological basis it is concluded that in sweet pea crossing-over may occur in an early stage of prophase and also at the time of disjunction. J. L.

Configurations of Gemini of Vicia.—T. MAEDA ("On the Configurations of Gemini in the Pollen Mother-Cells of *Vicia Faba*," *tom. cit.*, 125–37). In diakinesis there are five short gemini of approximately equal size (m-gemini) and one very long conspicuous geminus (the M-geminus) in *Vicia Faba*. There is a wide range of variation in the configuration of the gemini, due to the number of points of attachment of the component univalents. The number of these points

varies from 1 to 6 in the m-gemini, and from 3 to 13 in the M-geminus, the mean numbers being 3.5 and 8 respectively. The number of points of attachment is thus seen to be nearly proportional to the length of the chromosomes, which suggests that the number of attachments is determined simply by chance. Examples of all the types of gemini are figured. J. L.

Spiral Structure of Chromosomes.—N. SHINKE ("On the Spiral Structure of Chromosomes in Some Higher Plants," *tom. cit.*, 239–45). Numerous observations have been made on acetocarmine preparations to determine how widely the spiral structure of chromosomes may be distributed. Thirty-eight species and genera with relatively large chromosomes show the spiral structure. In plants with chromosomes of small size this structure is obscure, and the chromosomes appear as homogeneous solid masses. In plants with large chromosomes the spiral nature has been traced through the various meiotic divisions to the first division in the pollen grain. J. L.

Meiosis and Syndesis in *Rhæo*.—K. KATÔ ("Cytological Studies of Pollen Mother-Cells of *Rhæo discolor* Hance, with Special Reference to the Question of the Mode of Syndesis," *tom. cit.*, 139–61). A detailed description is given of the meiotic divisions in *Rhæo discolor*, in which $n = 6$. A third contraction occurs during the prophase, and on emerging from this the spiral structure of the chromosomes and doubleness of chromonema are seen. There is no formation of gemini at diakinesis, but the 12 univalent chromosomes are united in a ring. The spindle fibre attachment is subterminal in four chromosomes (heterobrachial chromosomes) and median in the remaining eight (isobrachial chromosomes). One pair of heterobrachial chromosomes lies diagonally opposite the other pair on the chromosome ring, and between each such pair a set of four isobrachial chromosomes is inserted. The mode of conjunction of two contiguous heterobrachial chromosomes is the same for each pair on the same ring. Both are joined either at their proximal ends or at their distal ends, and according to the mode of conjunction they pass either to the same or different poles. Polar granules are occasionally observed at the point of spindle fibre attachment of a chromosome. Non-disjunction resulting in a 5–7 division occurs in about 33 p.c. of the cases examined. The mode of syndesis is discussed on the basis of the way in which two contiguous heterobrachial chromosomes are attached one to the other. The author concludes that syndesis is a kind of parasyndesis in which the homologous elements are prematurely separated from each other, but the segmentation of the spireme is postponed so that a chromosome ring results. J. L.

Chromosome Arrangement in *Rhæo*.—K. KATÔ ("Chromosome Arrangement in the Meiotic Divisions in Pollen Mother-Cells of *Rhæo discolor* Hance," *tom. cit.*, 229–38). In the heterotypic metaphase the chromosomes are attached to one another in the form of a ring. There is thus no arrangement of chromosomes in definite patterns, as their free movement is prevented. In heterotypic anaphase the chromosomes are free from one another and assume various configurations. The normal number of chromosomes is six, but five and seven are often found as the result of unequal distribution towards the poles. In all these cases the chromosome arrangement which is of most frequent occurrence resembles the stable configuration of Mayer's floating magnets. This is also true of the homotypic metaphase if only the points of spindle fibre attachment of the chromosomes are considered. In the homotypic division the degree of resemblance to the floating magnets is, however, small. This may be regarded as due to the fact that the long chromosomes of this plant have to move in a relatively small space. J. L.

Meiosis in Narcissus.—S. NAGAO ("On the Meiosis in the Polyanthus *Narcissus*, *Narcissus Tazetta* L. Karyological Studies of the *Narcissus* Plant, II (Preliminary Note)," *Jap. Journ. Genetics*, 1930, 5, 159–71, Japanese with English summary). The following somatic chromosome numbers are given for garden varieties of the polyanthus narcissus: 20, 21, 22, 30, 31 and 32. Meiosis has been studied in varieties with 20, 22, 30 and 32 chromosomes. Size differences are apparent among the chromosomes. The variety with 32 chromosomes shows much meiotic irregularity, probably due to its hybrid nature. The number of gemini has not been determined. The other three types have 10 as the fundamental chromosome number, the increase in the 22-chromosome form being due to cross segmentation of a chromosome. *Narcissus* thus has both 7 and 10 as fundamental chromosome numbers. J. L.

Chromosome Arrangement in Narcissus and Lilium.—S. NAGAO ("Chromosome Arrangement in the Heterotype Division of Pollen Mother-Cells in *Narcissus Tazetta* L. and *Lilium japonicum* Thunb.," *Mem. Coll. Sci., Kyoto Imp. Univ.*, 1930, 5, B., 163–82). Two varieties of *Narcissus Tazetta* have been investigated—var. "*Franklin*," with 6 gemini distinctly larger than the remaining 4, and var. "*alba*," in which there are two kinds of pollen mother-cells, one with 10 and one with 11 gemini. In the former case 5 are large and 5 small, and in the latter case 4 large and 7 small. In both these varieties of *Narcissus* the arrangement of chromosomes which occurs most frequently is that resembling the stable arrangement of Mayer's floating magnets. In *Lilium japonicum* there are 12 gemini, which show continuous gradation in size and shape from the smallest to the largest. The most frequently occurring arrangement of chromosomes is that in which the number of inner chromosomes is less by one than that of the stable form of arrangement of floating magnets. This latter arrangement also occurs frequently and forms a second maximum. In both *Narcissus* and *Lilium* there is a tendency for the small chromosomes to occupy the inner positions rather than the large chromosomes. J. L.

Sex Chromosomes in Humulus.—H. KIHARA ("A Case of Linkage of Sex-Chromosomes with Autosomes in the Pollen Mother-Cell of *Humulus japonicus*," *Jap. Journ. Genetics*, 1929, 5, 73–80, Japanese with English summary). The following observations are made on a male plant of *Humulus japonicus*, which is abnormal as regards the behaviour of its sex chromosomes. In diakinesis there is one pentapartite chromosome and six normal bivalents. The pentapartite complex is formed by the end-to-end union of the sex chromosomes ($Y_1 X Y_2$) and an autosome pair (SS). These are united in the order $Y_1 SS X Y_2$. From the arrangement of this complex at metaphase, two kinds of gametes are expected, namely, $6 + S + S + Y_2$ and $6 + X + Y_1$. Separation of the linked elements is often seen, and will cause modifications of the types of gametes expected. In the second division groups of eight and nine chromosomes are seen. The fertility of the pollen grains has not been determined. J. L.

Chromosome Numbers in Linum.—M. KIKUCHI ("Cytological Studies of the Genus *Linum*., I," *Jap. Journ. Genetics*, 1929, 4, 202–12). The species of *Linum* investigated may be classified into four groups according to their haploid chromosome number: those in which $n = 9$ (9 species), $n = 15$ (5 species), $n = 18$ (*L. alpinum*) and $n = 43$? (*L. monogynum*). The hybrid *L. alpinum* ($n = 18$) \times *L. perenne* ($n = 9$) has been investigated and shows 27 somatic chromosomes. Meiotic irregularities occur leading to the formation of gametes with chromosomes

varying in number from 9 to 18. Root tips of a few F_2 plants have been examined, and show 20, 28 and 34 somatic chromosomes. J. L.

Chromosome Number in *Syringa*.—KARL SAX ("Chromosome Number and Behaviour in the Genus *Syringa*," *Journ. Arnold Arboretum*, 1930, 11, 7-14). The genus *Syringa* is divided into two subgenera—*Eusyringa* and *Ligustrina*. The former is further subdivided into the *Villosæ* and *Vulgares*. Most of the pure species of *Syringa* have either 23 or 24 pairs of chromosomes. Twenty-three pairs and a univalent are present in several *vulgaris* varieties. In *S. chinensis* (*Vulgares* group) there are 12 bivalents and 12 univalents. This is a hybrid between *S. persica laciniata* and *S. vulgaris*, and its chromosomal behaviour indicates 12 as the fundamental number in the genus. The species and varieties with 23 bivalents have originated through the loss of a pair of chromosomes in a tetraploid parent. *S. persica* and the variety *alba* are also considered to be derived from crosses of *S. persica laciniata* and *S. vulgaris*. They show 36 unpaired chromosomes at diakinesis. Although there is great similarity in the chromosome counts in *Syringa* species, no successful crosses have yet been made between species of the *Villosæ* and *Vulgares* groups. J. L.

Chromosome Numbers in *Vitis*.—KARL SAX ("Chromosome Counts in *Vitis* and Related Genera," *Proc. Amer. Soc. Hort. Sci.*, 1929, 32-3). The genus *Vitis* contains two subgenera—*Euvinis* and *Muscadinia*. All the numerous species of the *Euvinis* group examined have 38 somatic chromosomes. *V. rotundifolia*, the only species of the *Muscadinia* group, has 40 somatic chromosomes. This number is also found in *Ampelopsis* and *Parthenocissus*, with which *V. rotundifolia* is more closely related taxonomically than with other *Vitis* species. Species of the *Euvinis* group are interfertile and produce fertile hybrids. *V. rotundifolia* crosses with difficulty with the *Euvinis* species, and the hybrids obtained are sterile. No successful crosses have yet been made of *V. rotundifolia* and *Ampelopsis* or *Parthenocissus* species. It is suggested that some fundamental differences exist between the chromosome complexes of the two subgenera of *Vitis*. J. L.

Chromosomes in *Sorbopyrus* and *Sorbaronia*.—KARL SAX ("Chromosome Behaviour in *Sorbopyrus* and *Sorbaronia*," *Proc. Nat. Acad. Sci.*, 1929, 15, 844-5). Cytological studies have been made on the hybrids *Sorbaronia Dipelii* and *Sorbopyrus auricularis bulbiformis*. The former is completely fertile and shows 17 pairs of chromosomes in reduction division. There are no meiotic irregularities, and all the pollen grains appear to be functional. The latter hybrid produces fruit, but few seeds are developed. In reduction division there are 17 bivalent and 17 univalent chromosomes. Both first and second divisions are irregular and the pollen grains aborted. This hybrid is the result of the natural cross *Sorbus Aria* $n = 17$ and *Pyrus communis* $n = 17$, and is considered to be a back-cross of a diploid egg-cell of the F_1 hybrid with a haploid pollen grain from *Pyrus*. This variety resembles *Pyrus* in fruit characters more than the parental hybrid. This is explained by the presence of two sets of *Pyrus* chromosomes. J. L.

Chromosomes of *Rhododendron*.—KARL SAX ("Chromosome Stability in the Genus *Rhododendron*," *Am. Journ. Bot.*, 1930, 17, 247-51). Chromosome counts of representative species of the very polymorphic genus *Rhododendron* show that the fundamental chromosome number is 13. The number is found in the true *Rhododendrons* and in the *Azaleas*. Two tetraploid North American species were found belonging to two different subsections. Certain hybrids between Oriental

and American species show complete or almost complete compatibility of the parental chromosomes. These results indicate great stability in the genetic constitution of the chromosomes of *Rhododendron*. J. L.

Cryptic Types in *Datura*.—A. F. BLAKESLEE ("Cryptic Types in *Datura* due to Chromosomal Interchange, and their Geographical Distribution," *Journ. Hered.*, 1929, 20, 177-90). The author presents a detailed discussion of the effects of the presence of different extra chromosomes and of portions of chromosomes upon the adult characters within a highly inbred line of *Datura*. From configurations of three new types ($2n + 1$), as well as from their resemblance to known extra chromosomal forms, evidence is obtained that chromosomal interchange involving several different chromosomes has been taking place in this line since it was brought into cultivation. These types are primaries with an unmodified extra chromosome like the other two in the set affected, secondaries in which the extra chromosome has been formed by segmental interchange between two *homologous* chromosomes, so as to produce a chromosome with two similar ends, and tertiaries in which the extra chromosome has been formed by segmental interchange between *non-homologous* chromosomes. Evidence is given that interchange of segments between non-homologous chromosomes has been frequent in nature, and given rise to geographical races. J. L.

Chromosomal Constitution of Nubbin *Datura*.—A. F. BLAKESLEE ("An Attempt to Analyse the Composition of Nubbin, a Compound ($2n + 1$) Chromosomal Type in *Datura* (Abstract)," *Proc. Internat. Congress of Plant Sci.*, 1929, 1, 831-2). Nubbin is a unique type in *Datura Stramonium*, with a single extra chromosome, which appeared in a culture from a flower treated with radium emanation. From its morphology and the results of breeding experiments, the chromosomal formula for Nubbin is considered to be $2n - 1$ rolled $+ \frac{1}{2}$ sugar-loaf, $\frac{1}{2}$ strawberry $+ \frac{1}{2}$ polycarpic, $\frac{1}{2}$ mutilated. J. L.

Chromosome Circles in *Datura* and *Oenothera*.—A. F. BLAKESLEE and R. E. CLELAND ("Circle Formation in *Datura* and *Oenothera*," *Proc. Nat. Acad. Sci.*, 1930, 16, 177-89). The chromosomal phenomena of *Oenothera* and *Datura* are compared, and it is shown that segmental interchange is a possible basis of circle formation in both genera. J. L.

Segmental Interchange in *Oenothera*.—R. E. CLELAND and A. F. BLAKESLEE ("Interaction between Complexes as Evidence for Segmental Interchange in *Oenothera*," *tom. cit.*, 183-9). One is able to predict successfully the chromosome configurations in various complex combinations on the basis of segmental interchange. This leads to the conclusion that the phenomenon of segmental interchange is probably at the basis of circle formation in *Oenothera*. J. L.

Meiosis and Syndesis in *Oenothera*.⁴—D. G. CATCHESIDE ("Chromosome Linkage and Syndesis in *Oenothera*," *Trans. Roy. Soc., Edin.*, 56, pt. 2, 467-84). A detailed account of meiosis is given for *Oenothera pycnocarpa*, *Oe. nutans*, and a triploid form of *Oe. pycnocarpa*. In all three forms the single nature of the spireme can be observed as it emerges from the synizetic knot. In *Oe. pycnocarpa* and *Oe. nutans* there is a continuous ring of 14 chromosomes at late prophase, and in the triploid a ring of 21 chromosomes. The arrangement of chromosomes on the heterotypic spindle of the triploid is always irregular, though fundamentally zigzag. Abnormalities in the metaphase arrangement are also frequent in the diploids.

Non-disjunction may occur in the diploids giving a 6-8 division. In the triploid disjunction is usually 11-10, or rarely 12-9. Lagging chromosomes occur on the heterotypic spindle of the triploid, but do not result in polypory. The triploid *Oe. pycnocarpa* does not differ in external features from the diploids. It is suggested that in the triploid the paternal complement is represented twice. The parasynaptic interpretations of Boedijn, Kihara, and Darlington are discussed and found to be without adequate basis. J. L.

Chromosome Number in "Rabbit-eared Rogues" of *Pisum sativum*.

—I. BUNTEN ("A Preliminary Report on the Chromosome Complement of 'Rabbit-eared Rogues' in Culinary Peas (*Pisum sativum* L.)," *Am. Journ. Bot.*, 1930, **17**, 139-42). The "rabbit-eared rogue" is the narrow-stipuled mutation in culinary peas. The diploid chromosome number of both type and rogue is 14. It has yet to be determined if some change has taken place in the rogue affecting the shape or size of individual chromosomes. J. L.

Meiosis in Alfalfa.—R. G. REEVES ("Nuclear and Cytoplasmic Division in the Microsporogenesis of Alfalfa," *tom. cit.*, 29-40). In *Medicago sativa* the haploid chromosome number is 16, the diploid 32. The meiotic nuclear changes are described in detail. The method of chromosome pairing is parasynthetic, and the spindle is of cytoplasmic origin. Quadripartition of the mother-cell cytoplasm takes place by furrowing, preceded by a slight vacuolisation. The pollen grains are binucleate before dehiscence of the anther. J. L.

Anatomy.

Floral Morphology and Pollen Formation of *Hemerocallis*.—A. SIENICKA

("O budowie kwiatow i procesach tworzenia sie pyłku u *Hemerocallis fulva* fl. pleno," *Acta Soc. Bot. Poloniae*, 1929, **6**, 296-334, 28 figs., 3 pls., German summary). *Hemerocallis fulva* fl. pleno is a sterile species; the gynæcium has undergone partial or complete reduction. One process leading up to the formation of the double flower is median floral proliferation of the receptacle. On the proliferating axis are formed two new series of whorls in addition to the typical series for the flowers of *Hemerocallis fulva*. The second series consists of a triple ring of perianth leaves and a similar ring of stamens. The first series generally has a very large number of elements which are often fused. A much reduced gynæcium sometimes occurs at the top of the axis. Another factor contributing to the doubling of the flower is the development of the carpels into transitional structures, sometimes between carpels and stamens, sometimes between carpels and petals. In the transitional structures between stamens and petals the pollen-sacs undergo reduction in varying degree. The reduction may affect one, two, three or all four pollen-sacs. Sterile pollen is formed in the pollen-sacs. Details are given of the cytological processes in the formation of pollen. B. J. R.

Histological and Cytological Researches on Cleistogamous Flowers.—

T. GORCZYŃSKI ("Badania histo-cytologiczne nad kwiatami kleistogamicznymi u *Lamium amplexicaule*, *Oxalis Acetosella* i *Viola odorata*," *Acta Soc. Bot. Poloniae*, 1929, **6**, 248-95, 29 figs., 3 pls., French summary). In the cleistogamous flowers of *Lamium amplexicaule* two kinds of hairs are formed—(a) mechanical, round the edges of the pollen-sacs, and (b) secretory, in the slit between the two pollen-sacs. The transitory layer disappears very quickly. The nutritive layer develops normally and degenerates *in situ* without forming a periplasmodium. The arche-sporium consists of a layer of several rows of cells; the reduction division is normal

(in some cases there is a third division of the mother-cell). The number of pollen grains in each anther is different, but their size is constant. The pollen grain germinates in the anther; the pollen tube traverses the anther to reach the stamen, and proceeds to the stigma and through the conductive tissue of the pistil to the ovules; it reaches the embryo-sac by means of the micropyle. The embryo-sac develops at the expense of the inferior megaspore (chalazal). The karyokinetic division is normal. The embryo-sac contains eight nuclei; in the mature condition it contains the oosphere, two synergids, the secondary nucleus and three antipodals. The development of the albumen is cellular. Two haustoria develop from the albumen, one on the micropyle side, the other on the chalazal side. The latter develops first; it contains two nuclei and is short-lived. The former is polynucleate and is long-lived. The embryo develops from the fertilised oosphere. Degeneration of the stamens and ovules, especially the latter, is a common occurrence in cleistogamous flowers of *Lamium amplexicaule*. In *Oxalis Acetosella* the membrane of the anther consists of four layers; the mechanical layer does not always develop. No periplasmodium is formed from the nutritive layers. The number of pollen grains is reduced to 60 in each pollen-sac. Germination of the pollen grain takes place in the anther. The pollen tube generally traverses the groove between the two lobes of the anther, reaches the stigma and thence the ovules by means of the conductive tissue. Development of the embryo-sac is normal. It develops at the expense of the megaspore on the chalazal side, and contains eight nuclei in the mature condition. The embryo develops from the fertilised oosphere. In *Viola odorata* the nutritive layer develops and differentiates normally; after the active phase this layer degenerates without giving rise to a periplasmodium. The development of the archesporium is normal as far as the metaphase of the heterotypic division of the pollen mother-cell. The haploid chromosome number is 10. There is sometimes a complete absence of synchronisation in the development of the pollen grains, and the differences between corresponding stages are great; thus in one sac mother-cells in the prophase of the synaptic division and young pollen grains are found side by side. The second division sometimes follows an unusual course, the nuclei receiving five chromosomes. The germination of the pollen grain, preceded by the appearance of the germinative vacuole, takes place through a crack in the exine. The pollen tube generally makes its way out through the layers of the adjacent wall. Development of the embryo-sac proceeds normally, but degeneration often takes place in the young stages. The embryo develops from the fertilised oosphere, contrary to Winkler's hypothesis.

B. J. R.

Changes in the Upper Tree Limit deduced from Pollen Analysis.—

J. TRELA ("Wahania górnej granicy lasu na Babiej Górze w swietle analizy pylkowej," *Acta. Soc. Bot. Poloniae*, 1929, 30, 165–86, 8 figs., German summary). A short account is given of the present-day distribution of the forests in the area concerned. Material for pollen analysis was obtained from the sediment of a lake and from two peat moors. The following changes in the flora of the Babia Gora district are believed to have taken place during the last three post-glacial climatic periods. I. During the Atlantic period spruce forests mixed with fir and beech covered the lower slopes of the area. The elevation reached by these forests is unknown. II. During the sub-boreal period fir-beech-spruce forests prevailed at lower elevations. Spruce forests covered the higher elevations. Higher still was a limited zone of *Pinus montana*. III. The cooler, moister climate of the sub-Atlantic period allowed the fir and beech to spread downwards to the tableland of Little Poland. At the same time the lower limit of the spruce was extended to its

present position. *Pinus montana* attained its present distribution during this period. The lower forest belt of the Babia Gora mountains now consists of spruce with fir and beech. Higher up is pure spruce forest, and beyond this comes a broad zone of *Pinus montana*. B. J. R.

Vascular Variation due to Leaf Habit.—A. MONOYER ("Les variations vasculaires dues à la manière d'être des feuilles et l'établissement des types de structure," *Bull. Soc. Roy. Bot. Belgique*, 1929, **62**, 69-72). Species which differ in the size, structure and arrangement of their leaves, and consequently show decided differences in vascular anatomy, are classed as different types by some anatomists, although genetically they may be closely related. In studies of vascular anatomy it is important to investigate individuals of all ages grown under different conditions, and to distinguish between biological and phyletic characters. It is claimed that, although variation in leaf habit may affect vascular anatomy, comparative anatomy can eliminate the variations due to this factor. B. J. R.

Rate of Flow in Models of Wood Vessels.—B. J. GRIEVE ("The Influence of the Type of Thickening on the Rate of Flow in Models of Wood Vessels," *Proc. Roy. Soc., Vict.*, 1930, **42** (N.S.), 140-53, 1 pl., 6 figs.). The paper describes experiments carried out on models of wood vessels to test the comparative effect of different kinds of thickening on the rate of flow. The models were constructed of glass tubing with rubber tubing and rubber bands to represent the thickening on the vessel walls. The results show that reticulate and annular thickenings retard the rate of flow most. At high heads pitted thickenings offer less resistance to flow than does the spiral type, but at low heads spiral thickenings offer the least resistance to flow of the whole series. B. J. R.

Anatomical and Cytological Studies in Phylogeny.—K. SAX and D. A. KRIBS ("Chromosomes and Phylogeny in Caprifoliaceæ," *Journ. Arn. Arb.*, 1930, **11**, 147-53, 1 pl.). A study of chromosome number and size and wood structure in an attempt to determine the phylogenetic changes in structural specialisation in the Caprifoliaceæ. From the standpoint of wood structure the family contains primitive, specialised, and transitional genera. Genera with relatively primitive wood structure include *Viburnum*, *Diervilla* and *Kolkwitzia*. *Abelia*, *Symphoricarpos*, and *Lonicera* are intermediate or transitional in structural specialisation, while *Sambucus* is highly specialised. It is evident that, in this family, vascular specialisation does not run parallel with floral specialisation, since *Sambucus*, with highly specialised wood structure, is the most simple and primitive in floral development. It is also clear that there is no correlation between either chromosome number or size and the degree of vascular specialisation. Differentiation of genera appears to be associated with changes in chromosome size; changes in chromosome number are probably of minor significance. B. J. R.

Variation in Tracheid Length in *Picea sitchensis*.—L. CHALK ("Tracheid Length, with Special Reference to Sitka Spruce," *Forestry*, 1930, **4**, 7-14, 1 fig.). The following conclusions were reached from a study of the tracheids in a Sitka spruce tree about 40 years old. At a given height in the tree there is an increase in length from the pith outwards; this increase is least marked in the lowest section. In the same ring traced upwards, tracheid length increases to a maximum and then decreases. At the same number of rings from the centre, tracheid length is least at a height of 3 feet, increases rapidly to 16 feet, and remains approximately constant in the upper parts of the tree. Variation upwards appears to be largely due to differences in rate of increase from the centre outwards at

different heights. Summer-wood tracheids are about 12 p.c. longer than those of the spring-wood. In any cross-section the longest tracheids in any ring were usually from the narrowest part and the shortest from the broadest part of the ring. B. J. R.

Use of the Projection Apparatus in Anatomical Studies.—S. H. CLARKE ("The Use of the Projection Apparatus in Anatomical Studies of Timbers," *tom. cit.*, 40-4, 2 figs.). Descriptions are given of simple and rapid methods of making anatomical measurements by using a projected image of a section. The methods enable direct readings to be made of the dimensions and number of elements, and the proportions in which different elements are present. An instrument designed to determine the proportion of fibres or other elements in a sample of wood is described and illustrated. B. J. R.

Anatomy of Teratological Seedlings.—D. BEXON and A. E. WOOD ("Observations on the Anatomy of Teratological Seedlings. VII. The Anatomy of *Impatiens Roylei* Walp.," *Ann. Bot.*, 1930, **44**, 297-309, 30 figs.). The seedlings examined consist of hemitricotyls, showing all degrees of lobing, tricotyls, and an amphitrisyncotyl. In some hemitricotyls the modification of the vascular system is confined to the cotyledon, the hypocotyl and the root showing the tetrarch symmetry characteristic of the normal seedling. In such cases the vascular strands supplying the lobes of the abnormal cotyledon behave either as valves of the ordinary midrib bundle or as entire midrib and enlarged lateral. In the other hemitricotyls the abnormal cotyledon is associated with two root poles and pentarchy obtains, at least in the upper part of the hypocotyl. In the tricotylous seedlings hexarchy is rare; pentarchy is the typical condition, but may be attained in various ways. The structure of these seedlings is compared with that of *Althæa rosea* and other seedlings showing a similar type of transition. B. J. R.

Experimental Grafts between *Solanum* and *Iresine*.—S. V. SIMON ("Transplantationsversuche zwischen *Solanum melongena* and *Iresine Lindeni*," *Jahrb. f. wiss. Bot.*, 1930, **72**, 137-60, 6 figs.). It is shown that vegetative union can take place between two plants of widely separated families. Adsorption of the dead cells covering the cut surface, which usually occurs when two related species are grafted, does not take place. The living cells of the two partners only make contact after rupture of the dividing layer, which is heavily callosed. B. J. R.

Anatomy of the Thymeleaceæ.—J. LEANDRI ("Recherches anatomiques sur les thyméléacées," *Ann. Sci. Nat. (Bot.)*, 1930, **12**, 125-237, 26 figs.). A comprehensive investigation of the general anatomy of the family, including anatomical modifications due to climatic influence, characters of the vascular tissue of stem, rhizome and leaves, and floral anatomy. Anatomical characters do not suggest any new affinities of the Thymeleaceæ with other families; they are of value in indicating the distinctions between the various tribes and genera. B. J. R.

CRYPTOGAMIA.

Pteridophyta.

Genera of Polypodiaceæ.—EDWIN BINGHAM COPELAND ("The Oriental Genera of Polypodiaceæ," *Univ. Calif. Publ. Bot.*, 1929, **16**, no. 2, 45-128). An enumeration of 136 genera of Polypodiaceæ which occur in the Eastern hemisphere. They are arranged in five phyla based respectively on their oldest genera, namely,

Plagiogyria, *Dicksonia*, *Oleandra*, *Matonia*, *Antrophyum*. They are arranged and numbered in such an ingenious fashion as to show at sight the natural affinities and derivation of each genus in the phylum. Under each genus the type is defined, and the limitation and relationship of the genus are discussed; in two cases a new genus is described, in a few others the subgenera are defined. The author claims that his system is founded on many years of fern study in the field; that his genera are natural because each genus is based on a definite type and is limited to species of evident and real affinity to that type; and that if some of his genera (e.g., *Dryopteris*, *Polypodium*) are too large, they can readily be divided into smaller and more convenient subgenera or genera, each based similarly on a definite type. A large number of problems, of course, remain unsolved and await further investigation. A. G.

Taxonomic Fern Studies.—CARL CHRISTENSEN ("Revision of the Polypodioid Genera with Longitudinal Cœnosori (Cochlidiinæ and 'Drymoglossinæ'), with a Discussion of their Phylogeny," *Dansk Bot. Arkiv.*, 1930, 6, nr. 3, 1-93, 13 pls., 1 fig.). A monographic review of the species of 13 genera which fall into two groups:—(1) the *Cochlidiinæ*, comprising 3 genera—*Cochlidium*, *Scleroglossum* and *Nematopteris*—in which are included a few species previously classed under *Monogramma* or *Vittaria*, but really of Polypodioid affinity. The natural position of this well-defined tribe is in Polypodieæ. (2) The other group, comprising 10 genera, corresponds chiefly to the tribe Tænitidinæ of Diels (with the exclusion of *Tænitis* and *Platytaenia*). This name (Tænitidinæ) cannot be retained for a group which excludes *Tænitis*, and so Drymoglossinæ is suggested as a temporary substitute. But the group is not really a natural tribe; though alike in having longitudinal exindusiate cœnosori, they are not necessarily of close relationship. The fusion of single sori into cœnosori is an evolutionary state arrived at independently by recent derivatives from various groups of the Polypodieæ, and may be an intermediate step in development from the polypodioid to the acrostichoid state. It seems best to place these 10 genera under the heading Drymoglossoid genera derived from the Polypodieæ, and the genera in question are the following:—*Eschatogramme* Trev., *Marginariopsis* (new), *Lemmaphyllum* Presl., *Drymotænium* Makino, *Hymenolepis* Kaulf., *Paltonium* Presl., *Myuropteris* (new), *Pycnoloma* (new), *Grammatopteridium* v.A.v.R., *Drymoglossum* Presl. Each of these, with its species, is described, and its particular affinity with some section of Polypodieæ is discussed. A. G.

Cerosora.—KAREL DOMIN ("Cerosora, a New Genus of Ferns," *Acta Botanica Bohemica*, 1929, 8, 3, 4, 1 pl.). Description of *Cerosora*, a new genus of ferns, endemic in Borneo, and founded on *Gymnogramme chrysosora*, described by J. G. Baker in 1887. It is allied to *Pityrogramma* and *Gymnogramma*, but is distinct in having hair-like septate trichomes in place of the usual scales of *Pityrogramma*, and the fertile fronds are covered beneath by a golden waxy powder. A. G.

Lindsaya.—R. E. HOLTTUM ("The Genus *Lindsaya* in the Malay Peninsula," *The Gardens Bulletin, Straits Settlements*, 1930, 5, 58-71, 9 figs.) A revision of the species of *Lindsaya* found in the Malay Peninsula, with a key and several figures. Two new species are described. The revision is based on a study of ample material (which is essential) and upon field observations of the definite habitats of the plants. A. G.

Schizæa.—D. R. BARTOO ("Origin of Tissues of *Schizæa pusilla*," *Bot. Gaz.*, 1930, 89, 137-53, 27 figs.). An account of the structure of *Schizæa pusilla*. The root

has a tetrahedral apical cell, from the segments of which early and in order are differentiated the epidermis, cortex, endodermis, pericycle, protophloem, protoxylem, metaxylem, metaphloem. The inner layer of the cortex and the endodermis originates from a common mother-cell which is cortical. The pericycle and desmogen strand originate from a common mother-cell which is stelar. The root cap formed from the apical segment of the apical cell remains very simple, only four cells being formed. The root hairs are as long-lived as the root. The root takes origin in a single cell of the meristematic region of the rhizome, the sister-cells giving rise to endodermis and pericycle. The *rhizome* also has a tetrahedral apical cell, from which the tissues are differentiated early just as in the root; the endodermis and pericycle have a common mother-cell which is cortical. The *leaf* arises from the first outer derivative of the immediate segment cut from the apical cell of the rhizome. The rudimentary leaf has a two-sided apical cell, which becomes transformed into a hemispherical apical cell and finally into a marginal row of meristematic cells. The tissues differentiate in the same order as those of the root; the endodermis and pericycle have a common mother-cell which is cortical. A. G.

Equisetum in Spain.—JUSTO RUIZ DE AZÚA ("Equisetos del condado de Treviño (Burgos)," *Bol. Real Soc. Española Hist. nat.*, 1929, 29, 365-8). A list of the species, varieties, sub-varieties and forms found in the county of Treviño, in the Spanish province of Alava. All are new records for the particular district, and several varieties are new to the Spanish flora. In all, five species are recorded, with numerous varieties, each of which is defined with a brief description. A. G.

Galician Ferns.—J. RUIZ DE AZÚA ("Helechos de Galicia (2ª serie)," *op. cit.*, 1930, 30, 129-34, 2 figs.). A second contribution of ferns from the province of Pontevedra, comprising 5 species and 28 varieties, some of which are new for Galicia and some for Spain. In the notes attention is called to distinctive characters, in others the typical characters are emphasised. The previous paper contained 13 species and 43 varieties. A. G.

Basque Archegoniatae.—EMILIO GUINEA ("Arquegoniadas del país vasco," *tom. cit.*, 141-2). A list of six ferns and a *Sphagnum* from the Basque provinces, with annotations, including *Dryopteris Phegopteris*, the presence of which had been doubted, and *D. africana*, which was first recorded for Europe in 1909. A. G.

Bryophyta.

Ceylon Mosses.—H. N. DIXON ("Notes on Thwaites's Ceylon Mosses," *Journ. Bot.*, 1930, 68, 1-10). A series of notes on the set of Ceylon mosses issued by Thwaites, the new species of which were described by Mitten. The present paper amounts to a revision, in the light of modern research, and special attention is paid to the smaller species of *Fissidens*, which, in the making up of the sets, were not critically distinguished. A key is provided for verifying these perplexing little species. The genus *Spharothecium*, about which there has been a strange misunderstanding, is definitely re-established. A. G.

American Mosses.—GEORGE NEVILLE JONES ("The Moss Flora of South-Eastern Washington and adjacent Idaho," *Research Studies, State Coll., Washington*, 1929, 1, 113-92, 1 map). An account of the moss flora of the adjacent parts of the States of Washington and Idaho, with keys to the families, genera, species, also brief descriptions, habitats, and remarks. In the introduction are notes on classification, habitats, zonal distribution, earlier collectors. A. G.

Swiss Bryophytes.—J. AMMAN and C. MEYLAN ("Nouvelles additions et rectifications à la flore des muscinées de la Suisse (sixième série)," *Bull. Soc. Vaudoise Sci. Nat.*, 1930, **57**, 121–44, 3 figs.). A list of about 100 species of mosses and 64 hepatics, representing additional records for the cantons and new species, as well as corrections of former determinations. *Bryum* (*Mesobryum*) *mesodon* and *Leskella cuspidata* are new to science, and are described and figured. *Hypnum alpestre* is new to the Swiss flora. Some critical notes are added. A. G.

Mosses of Morocco.—J. AMMAN ("Contribution à la flore cryptogamique du Maroc," *Bull. Soc. Vaudoise Sci. Nat.*, 1930, **57**, 145–6). A list of 13 mosses gathered by P. Jaccard, mostly on the Atlas Mountains in Morocco in 1926. They are all acrocarpous species. An appendix of six lichens is added by Rouly de Lesdain. A. G.

Subarctic Moors.—N. J. KATZ ("Zur Kenntniss der Moore Nordost-europas," *Beihefte zum Botanischen Centralblatt.*, 1930, **46**, Abt. 2, 297–394, 1 map, 5 figs.). An account of the plant associations of the moors of northern Russia. Twenty-seven such associations are described. They are named after some characteristic moss constituent; thus 13 are named after species of *Sphagnum*, and six after hypnaceous species, others after other bryophytes and lichens. A. G.

Thallophyta.

Algæ.

Ochrosphæra.—BRUNO SCHUSSNIG ("*Ochrosphæra neapolitana*, nov. gen., nov. spec., eine neue Chrysomonade mit Kalkhülle," *Osterreich. Bot. Zeitschr.*, 1930, **79**, 164–70, 4 figs.). A description of a new species of a Chrysomonad observed on cultures in the zoological station at Naples. The structure of the cell is described, its cytology, its division, spore formation, the structure of the ciliated spores. Details of the finer structure of the calcareous envelope of the cell are added. A. G.

Glæotænium.—F. STOCKMANS ("Contribution à l'étude de *Glæotænium Loïlesbergerianum* Hansg.," *Bull. Soc. Roy. Bot. Belg.*, 1930, **62**, 2^{me} série, 101–4, 4 figs.). *Glæotænium Loïlesbergerianum* was found in the lakes of Overmeire, near Ghent, in 1921. The nature of the black bands which surround and separate the cells in the colonies is discussed. By microchemical tests it is shown that the black band is simply a deposit of calcium carbonate. The alga is found in water where calcified Characæ abound. A. G.

Cymatopleura.—BOHUMIL CYRUS ("Étude monographique du genre *Cymatopleura* W. Smith," *Acta Botanica Bohemica*, 1929, **8**, 128–46, 2 figs.). An account of the history and phylogeny of the Bacillariales. The author inclines to the view that the Bacillariaceæ are derived from the Chrysomonaceæ (Flagellata), but he says that we must await the latest discoveries about the zoospores of the Bacillariaceæ to get an explanation of their origin and parentage. He then gives an account of the genus *Cymatopleura*, the classification of its species and varieties, its geographical distribution, the construction of its valve, the reproduction, then details about the variability in size of the valves, with tables of measurements and diagrams. This is followed by lists of diatoms found associated with species of *Cymatopleura* in various localities. A. G.

Sea Diatoms.—MARIE V. LEBOUR ("The Planktonic Diatoms of Northern Seas," *Ray Society, London*, 1930, 8vo, i–ix, 1–244, 4 pls., 181 figs.). An account

of the planktonic diatoms of the north-eastern Atlantic, with descriptions of the genera and species, and numerous figures. The introduction gives a *résumé* of the morphology, nutrition, reproduction, habits, etc., of these oceanic diatoms, and of the parasites with which they are liable to become infested or associated. The volume contains 22 pages of bibliography. A. G.

Norwegian Lakes.—KAARE MUNSTER STRØM ("Limnological Observations on Norwegian Lakes," *Archiv für Hydrobiologie*, 1930, **21**, 97–124, 1 pl., 5 figs.). The author discusses the position of limnology, particularly as concerns the lakes of Norway, the scientific methods by which they should be investigated, and some newer methods that may be applied. He then describes some lakes near Vossevangen which he explored, and the plankton which he obtained, as well as the physical and chemical results. To these he appends the results of his study of Bolstadfjord, which is cut off from the sea by a sound with two bars, and contains fresh water down to a depth of some 23 metres. In conclusion he sums up the features of the lakes surveyed, and discusses some questions of lake typology, indicating the characters which must be observed in comparing lake with lake—especially the oxygen curve in summer, the colour, transparency, pH value, specific conductivity of the water, then the bottom fauna and bottom deposits, and thirdly the plankton. A. G.

Coleochaete.—OPHELIA C. WESLEY ("Spermatogenesis in *Coleochaete scutata*," *Bot. Gaz.*, 1930, **89**, 180–91, 2 pls.). The antheridia of *Coleochaete scutata* are produced between June and October in the Chicago region; they are produced in bands originating from the division of a single cell or groups of cells, half-way between centre and circumference of the thallus disc; outer and inner bands arise later. A vegetative cell is divided into two antheridia mother-cells, by whose division antheridia are formed. The sister-cell of the second antheridium is a large seven-sided vegetative cell, which remains after the escape of the two antherozoids from the antheridia. More than four antheridia may be developed from one vegetative cell. The outer wall of the sister-cell of the last antheridium formed becomes rounded and thickened, until it resembles that of a vegetative cell. Hairs are sometimes produced by these sister-cells of the last antheridium formed. In some antheridia the chloroplasts are normal, in others they appear to be disintegrating, and from others they are absent. The antherozoids formed from each mother-cell escape through a common pore. A. G.

Callithamnion.—M. A. WESTBROOK ("Callithamnion tetricum (Dillw.) Ag.," *Journ. Bot.*, 1930, **68**, 193–203, 13 figs.). An account of the red alga, *Callithamnion tetricum*, its habit, its male, female, and tetrasporic plants, with a discussion of the occurrence of sporangia on sexual plants, and notes on the periodicity of reproduction. A. G.

Belgian Algæ.—H. KUFFERATH ("La florule algologique de Rouge-Cloître," *Bull. Soc. Roy. Bot. Belg.*, 1930, **62**, 2^{me} série, 87–98). A description of the lakes of Rouge-Cloître, of their environment, and of their geographical and geological position. They form one of the localities richest in freshwater algæ in Belgium. A complete list of the species hitherto recorded is given, 104 in number, and to these the author adds 113 more, raising the total to 217; among them are 117 diatoms. The actual source of each species is indicated by cross-reference numbers. A. G.

Algæ of Spanish Morocco.—PEDRO GONZÁLEZ GUERRERO ("De la flora hispano-marroquí (agua dulce)," *Bol. Real Soc. Española Hist. nat.*, 1929,

29, 361-4). An enumeration of 15 Schizophyceæ and 52 other freshwater algæ, partly collected in Larache and Melilla, in Spanish Morocco, and partly in the Spanish peninsula, near Madrid and Toledo. Among the algæ previously unrecorded for Spain is the genus *Diplocolon*. A. G.

Suez Canal Migrants.—ACHILLE FORTI ("Nuove segnalazioni di Alghe passivamente trasportate a traverso al canale di Suez, poi naturalizzate," *Nuov. Giorn. Bot. Ital.*, 1928, **34**, 1443-51, 6 pls.). So long ago as 1894 Nemetz collected at the island of Rhodes, in the Mediterranean, two marine plants which are natives of the Red Sea and Indian Ocean—the phanerogam *Halophila stipulacea* and the red alga *Hypnea Valentia*. Dr. Forti states that R. Issel again collected the *Halophila* at Rhodes in 1926, and he discusses various algæ which have migrated through the Suez Canal. *Hypnea musciformis* is a Mediterranean species which has been found at Suez. *Hypnea nidifica*, recorded from Hawaii, California and Somaliland, has been collected at Simi Island in the Dodecanese. *Hydroclathrus cancellatus* was also collected at Simi by R. Issel, and is another migrant from the Red Sea, Indian Ocean, etc. *Colpomenia sinuosa* is another such migrant which, early in the present century, travelled on along the coasts of France and reached our own southern shores. A. G.

Canary Algæ.—F. BÖRGESSEN ("Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceæ: Part II, Cryptonemiales, Gigartinales and Rhodymeniales," *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, 1929, **8**, 1, 1-97, 4 pls., 31 figs.). A further instalment of the author's study of the algæ of the Canary Islands, carrying the account on through three groups of red algæ, Cryptonemiales, Gigartinales and Rhodymeniales. The Corallinaceæ have been worked out by Mme. Lemoine, and several of them are figured in the plates. In the present instalment 73 species are discussed, 29 of which belong to the Corallinaceæ, and about half have a distribution reaching to the West Indies, or are very closely related to West Indian species. A. G.

Argentine Algæ.—HANS SECKT ("Stand der Phykologie in der Argentinischen Republik," *Ber. Deutsch. Bot. Ges.*, 1930, **48**, 98-108). A survey of what has been published upon the algal flora of the territories included in the Argentine Republic, together with a bibliography of 51 works. A. G.

Fungi.

Study of Blastocladia.—F. B. COTNER ("Cytological Study of the Zoospores of *Blastocladia*," *Bot. Gaz.*, 1930, **89**, 295-309, 10 text-figs.). The methods employed to secure pure cultures are described; the plants were obtained by suspending apples in a pool infested by the organism. There has been considerable difference of opinion as to the number of cilia developed on the zoospores and as to other characters owing to the constant presence of bacteria. Cotner, by his pure cultures, has proved that the uniciliate condition is typical; the cilium is attached to the tip of the nucleus, and there is also a definite blepharoplast at the insertion of the cilium on the plasma membrane. Imperfect environmental conditions affect the cleavage of the protoplasm in the sporangium and induce the formation of two or three cilia. Temperature is of great importance; the optimum for zoospore formation lies between 11° and 14° C. A. L. S.

Study of Synchytrium.—SHUNSUKE KUSANO ("The Life-History and Physiology of *Synchytrium fulgens* Schroet., with Special Reference to its Sexuality," *Jap. Journ. Bot.*, 1930, **5**, 35-132, 19 text-figs.). The fungus in

question is parasitic on leaves and stems of *Oenothera* spp. By extensive culture experiments a thorough study of the fungus has been made in all its aspects, but with particular reference to the sexuality of the gametes. The results are summarised as follows:—The zoospore is the planogamete; the zygote is the product of two copulated gametes and becomes the resting cell—a single gamete may develop parthenogenetically into the summer gametangium. The resting cell germinates and forms the winter gametangium. The gametes are morphologically similar, but one that comes to rest takes a spherical form and acts as a female. Copulation takes place between gametes from the same gametangium. Other observations on the influence of temperature, moisture, etc., are given. The resting cells remain viable for seven years. A list of contents is given for this long paper, as well as a list of the literature cited.

A. L. S.

Forms of *Albugo candida*.—MAKOTO HIURA ("Biologic Forms of *Albugo candida* (Pers.) Kuntze on some Cruciferous Plants," *Jap. Journ. Bot.*, 1930, 5, 1-20). Hiura has made a series of inoculation experiments with the white rust of crucifers as it occurs in Japan on various cruciferous plants. He has established the existence of several distinct forms. The plants tested were radish, *Raphanus sativus*, Aburana, *Brassica campestris*, Chinese mustard, *Bassica juncea*, and many others. The fungus on radish he found would infect all varieties of radish, but no other crucifer; that on Chinese mustard would not infect radish. The first-mentioned, "aburana," was also limited in its liability to infection. The author gives a complete account of his experiments and a list of literature.

A. L. S.

Fructification of *Aphanomyces*.—F. K. SPARROW ("The Non-Sexual Stage of *Aphanomyces phycophilus*," *Mycologia*, 1930, 22, 118-21, 1 text-fig.). The fungus was described by de Bary as parasitising algæ, but only the sexual stage was known. Sparrow has found a specimen infecting the internodal cell of a *Nitella* and producing sporangia. The fungus was conspicuous owing to its bright golden oospores with spine-like protuberances. Sparrow was fortunate enough to find also the sporangia.

A. L. S.

Studies of *Pythium*.—H. H. FLOR ("Relation of Environmental Factors to Growth and Pathogenicity of *Pythium* isolated from Roots of Sugar-Cane," *Phytopathology*, 1930, 20, 319-28). This is a record of investigation on the influence of temperature, moisture, etc., on the development of *Pythium*. Corn was used for these tests instead of sugar-cane. It was found that the growth rate of cultures increased up to 30° C. In strongly parasitic forms it fell off sharply at 36° C., and at the higher temperature injury to corn ceased. It increased, however, with the water content of the soil, and always more in cold weather. A *Pythium* culture grew well in pH 5.3 to 9.2. It did not grow at pH 4.6.

A. L. S.

Study of *Allomyces*.—H. KNIEP ("Ueber den Generationswechsel von *Allomyces*," *Zeitschr. für Bot.*, 1930, 22, 433-41, 2 text-figs.). Kniep has been successful in seeing the developments of *Allomyces* in pure cultures. From the zygote there were produced mycelia giving rise to zoosporangia and also resting cells, but not gametangia. Mycelia bearing gametangia, but not zoosporangia, arise from the resting cells. These resting cells are formed at the end of the hyphæ. Kniep has traced the growth of these different bodies, the nuclear developments, and the reaction to different types of culture conditions; he has also followed

the formation of the male and female gametangia produced from the resting cells in which reduction has taken place, and the gametes of which fuse to form the zygote representing the diploid sporophyte stage.

A. L. S.

Ceratostomella and Graphium.—CAROLINE T. RUMBOLD ("The Relationship between the Blue-Staining Fungi *Ceratostomella* and *Graphium*," *Mycologia*, 1930, 22, 175-9). Rumbold has made a comparative study of these two fungi, which are both chromogenic, staining the wood blue on which they grow. She has made cultures of both species, and finds reason to consider the *Graphium* as a stage of *Ceratostomella pilifera*, "one of the commonest blue-staining fungi in lumber yards," of which there are a number of different strains.

A. L. S.

Ascomycetes.—FRED J. SEAVER ("Photographs and Descriptions of Cup-Fungi. XI. *Solenopezia*," *tom. cit.*, 122-4, 1 pl.). The paper is a description of the type specimen of the genus, and was originally described as *Peziza Solenia*. The minute ascomata are almost closed and covered with hairs; the spores are elongate and 1-septate.

A. L. S.

Cup-Fungi.—FRED J. SEAVER ("Photographs and Descriptions of Cup-Fungi. XII. *Elvellaceæ*," *tom. cit.*, 163-4, 3 pls.). Seaver contributes photographs of these larger *Pezizaceæ*. *Elvella californica* is given two representations—a species recently found in Washington, a very large fungus about 8 inches across. Another very large species, *Morchella crassipes*, from New York State, has also been photographed.

A. L. S.

Sporobolomycetes.—H. G. DERX ("Étude sur les sporobolomycètes," *Ann. Mycol.*, 1930, 28, 1-22, 1 pl.). *Sporobolomycetes* was established by Kluwyer and Van Niel, in 1924, as a new yeast genus. Owing to the colour, the species was named *S. salmonicolor*. Other species also coloured have been discovered and described, and Derx has added another genus, *Bullera*, in which the yeast cells are colourless, both being members of the new family *Sporobolomycetes*. The species were isolated chiefly from honey-dew and leaves, and were cultured by Derx. The stages of growth and relation to various culture media are described for the species, with their chemical and other characters. Several of the species had been described under other genera—*Torula*, *Saccharomycetes*, etc.

A. L. S.

New Species of Aspergillus.—MAX ROBERG ("Zwei bisher unbekannte Aspergillen," *Hedwigia*, 1930, 70, 137-9). The two species appeared in cultures while the author was making a physiological study of the *Aspergilli*. In the first, *A. aureoglauca*, the colour of the conidial plant was golden-olive green. Perithecia with asci and spores appeared in a few days in large numbers, rather large, and of a clear golden-yellow colour. This species belongs to the *Glaucus* group. The second, *A. amœnus*, was originally found on barberry fruits, and belongs to the *Nidulans* group. The conidial stage is green with a bluish tinge. No other fructification developed. The reaction of these fungi to temperature is given, and their colour production—in *A. amœnus* crimson and orange on the culture plate.

A. L. S.

Study of Chaetomella.—MARJORIE E. SWIFT ("A New Species of *Chaetomella* on Rose," *Mycologia*, 1930, 22, 165-8, 1 text-fig.). The pycnidia of the fungus were solitary or in small groups on twigs of *Rosa* and *Rubus*. It was cultivated on artificial media, and the microscopic characters noted and compared with other recorded species. It was found to be new to science, and is recorded as *Chaetomella raphigera*.

A. L. S.

Fructifications of Chætomella and Pezizella.—B. O. DODGE ("Development of the Asexual Fructifications of *Chætomella raphigera* and *Pezizella Lythri*," *tom. cit.*, 169-74, 2 pls.). Dodge has followed, by means of artificial cultures, the comparative development of these two species, and has noted the effects of the culture medium on the formation of the fruit body. Thus in *Chætomella*, in nature, the pycnidium originates as a mound of tissue beneath the epidermis; in artificial cultures there is a mat of mycelium formed on the surface, and a foot structure enlarged above precedes the pycnidium. *Pezizella* was also cultured, and was found to be susceptible to the changes in humidity. Other peculiarities are noted.

A. L. S.

Acrothecium obovatum.—BAILEY K. ASHFORD and RAFFAELLE CIFERRI ("A New Variety of *Acrothecium obovatum*," *tom. cit.*, 180-5, 2 text-figs.). This fungus grows on human skin, but is easily cultured on sugar or peptone-sugar agar. *Acrothecium* is a genus of Dematiaceæ. The fructification is generally scanty; the conidia are subclavate or fusiform, 1 or more septate, and brown. The one described as *Acrothecium obovatum* var. *subcapitulatum* has been carefully studied and compared with other species.

A. L. S.

Penicillia.—CHARLES THORN (London: Baillière, Tindall & Cox, Henrietta Street, Covent Garden, 1930, i-xiii, 1-644, 99 text-figs.). This comprehensive volume treats the genus *Penicillium* under every aspect. Thorn gives first an account of the genus and species as understood now and also in former days. He writes of their history, their economic aspects, more particularly of the scientific problems—their composition and production. Their physiological activities are discussed—their parasitism or saprophytism, and their reaction to light, moisture, etc. The main part of the book is, however, taken up with systematy: they are included in the family Mucedinaceæ, sub-group Aspergillæ. All known species are recorded, many of them studied in the laboratory by various culture methods. There are 443 species described, along with a few species under closely-allied genera.

A. L. S.

Indian Hyphomycetes.—H. VON SYDOW and W. McRAE ("Hyphomycetes indiæ orientalis," *Ann. Crypt. exotique*, 1929, 2, 262-71). The paper deals only with the genus *Cercospora*, which is abundant in the East Indies. Collections were made over a long series of years, and from many districts. Many new species were determined. Their habitat is the leaves of a great variety of plants.

A. L. S.

Rhizomorpha melolonthæ.—A. SARTORY, R. SARTORY, and J. MEYER ("Étude d'une mucédinée nouvelle, '*Rhizomorpha melolonthæ*,' isolée du tube digestif du Hanneton commun (*Melolontha vulgaris*)," *Ann. Mycol.*, 1930, 28, 24-8, 3 text-figs.). The new fungus was isolated from the digestive tube of the cockchafer. Isolation and culture methods are described. An abundant growth was secured, the principal characteristic being the formation of chlamydospores; otherwise the fungus falls into the group *Mycelia sterilia*. The mycelium becomes dark-coloured or almost black as growth proceeds.

A. L. S.

Fungi of Santo Domingo. III. Uredinales.—F. D. KERN and R. CIFERRI (*Mycologia*, 1930, 22, 111-17). Papers have already been published on rusts in Santo Domingo. The present account is of a series collected by Ciferri in 1929. The list contains species on new hosts and a number new to the locality. One of these, *Pucciniastrum Agrimonix*, is new to the West Indies. Thirty species are recorded, one—*Aecidium domingensis*—new to science.

A. L. S.

Study of Uredineæ.—H. J. MARESQUELLE ("Études sur le parasitisme des Urédinées," *Ann. Sci. Nat. Bot.*, 1930, ser x, 12, 1-123, 4 pls., 43 text-figs.). Maresquelle divides his study into two portions:—(1) physiological, mainly concerned with the reactions (respiration and assimilation) of the host; and (2) morphological, the hypertrophies and deformations due to the parasite. As regards respiration, he finds a heightened activity in the invaded tissues, that this is confined to the region occupied by the parasite, and is most evident just before the maturity of the fungus spores. As to assimilation, chlorophyll in the cells is largely destroyed, and carbohydrates are drawn from the neighbouring tissues, which become extremely active. This alteration he describes as heterotrophy. In the second part he classifies four types of deformation—local hypertrophy inducing tumefactions, and the more wide-spreading through the host, inducing hypertrophy of the organs invaded, finally two types of witches' brooms, causing different types of branching. He gives a list of the Uredines that are involved in "broom" formations. A. L. S.

Puccinia mirabilissima.—MALCOLM WILSON ("The Distribution of *Puccinia mirabilissima* (Peck) in Europe, and the Occurrence of an *Aecidium* provisionally assigned to this Species," *Ann. Mycol.*, 1930, 28, 225-9). The above *Puccinia* was described first in America in 1881. It was found on *Berberis Aquifolium* in Scotland in 1922, and since then has been collected in several localities in central and southern Scotland. An account of the occurrence of the various stages of the fungus is given. It has since been found in Denmark (1925), and later still in Holland and Germany. Wilson discusses the probable introduction and dissemination of the fungus in the European countries: its progress seems to have been continually eastwards. Only the æcidia are known; it is suggested that it may be a stage of *Puccinia graminis*. A. L. S.

A New Urocystis.—KOGO TOGASHI and FUSAJI ONUMA ("A New Species of *Urocystis* on *Convallaria majalis* L.," *Jap. Journ. Bot.*, 1930, 5, 21-5, 1 text-fig.). The fungus sori on the leaves and sheaths are greyish-black, warted, and visible on both sides of the leaf. The authors, having compared it carefully with species occurring on allied plants, finally describe it as new to science—*Urocystis Mizabeana*. A. L. S.

Ustilaginales on Andropogon.—G. L. INGRAM ZUNDEL ("Monographic Studies on the Ustilaginales attacking *Andropogon*," *Mycologia*, 1930, 22, 125-58). Zundel has described 76 species, belonging to five genera, that are parasites on *Andropogon*. These genera are *Cintractia*, *Sorosporium*, *Sphacelotheca*, *Tolyasporella* and *Ustilago*. *Sphacelotheca* contributes 39 species, the largest number. The specimens are from all countries, and as far as possible are a complete series. A number of species are new to science, and Zundel's studies have led to the formation of several new combinations. A. L. S.

Japanese Basidiomycetes.—TOKUTARO ITO ("Symbolæ ad mycologiam japonicam. IV. *Asterostromella* et *Hymenochæte*," *Bot. Mag.*, 1930, 44, 89-93). The author has described a series of fungi new to Japan, with full references. Most of them have been recorded from Europe as well as from Eastern countries. One species, *Hymenochæte Mimosa* Lloyd, is endemic in Japan, where it has occurred in many different localities. A. L. S.

Notes on Russula.—V. MELZER ("*Russula helodes* sp. n.," *Bull. Soc. Mycol., France*, 1930, 45, 284-6, 1 col. pl.). Melzer describes this new species as near to

R. maculata, but differing in the presence of cystidia in the skin on the cap and foot, and also in the colour of the massed spores, egg-yellow. The specimens were largely immersed in the soil. A. L. S.

Russula adusta and R. albonigra.—MM. MELZER and ZOARA (*tom. cit.*, 287-9). The authors indicate the points of difference between these *Russulae* and other dark species. The principal character is that they do not turn black when touched, or with age. There are various reactions with chemical solutions that also emphasise the difference, such as the colour produced by sulphate of iron. With *R. albonigra* the reaction is rose-grey, becoming green; with *R. adusta* the rose-grey colour remains for a considerable time, changing at length to a dull green. The latter fungus is the most abundant in the forests. A. L. S.

Spores of Agarics.—R. KUHNER and J. BOURSIER ("La forme des spores chez les agarics rhodo-goniosporés (genre *Rhodophyllus* Quélet)," *Bull. Soc. Mycol., France*, 1930, **45**, 264-77, 2 pls., 6 text-figs.). The spores of the above group are generally angular in form, and the authors have sought to place them in definite groups. They find that there are two types of base: in the first, two lines or angles rise from a basal point; in the other, three lines are present. The angular characters of the spores are represented, but there are many variations which are described. The whole scheme is elaborate and detailed. A. L. S.

Notes on Russula.—M. JOSSE RAND ("Note sur *Russula integra* (L.) Fries," *tom. cit.*, 278-83, 1 text-fig.). The species here discussed included at one time a number of allied forms. The writer has delimited the true species, and has given a careful description of macroscopic and microscopic characters, special attention being given to the form of the cystidia and to the echinulations of the spores. A. L. S.

Dehiscence of Geasters.—W. H. LONG ("The Dehiscence of *Mycenastrum corium*," *Mycologia*, 1930, **22**, 103-5, 1 pl.). In most geasters the peridia open when wet, and close more or less when dry. Long describes the opposite case in *Mycenastrum*, which closes when wet. This is due to the outer layer of the peridium, the cells of which absorb water and expand, thus closing the top of the geaster. On drying they shrink and cause the peridium to open and curve outward. A. L. S.

Effect of Substratum on Fungi.—M. L. LUTZ ("Nouvelles expériences sur la spécificité des champignons hyménomycètes lignicoles vis-à-vis de leurs supports.—Sur la spécificité du *Corticium quercinum*," *Bull. Soc. Mycol., France*, 1930, **45**, 261-3). Lutz has proved by experiment that *Corticium quercinum* is not confined to oak; he was able to grow it on the wood of a number of trees after these had been treated with water to remove "antagonistic substances." The mycelium not only continued to grow, but in two cases the fruiting body was formed. The colour was, however, changed in some instances—sometimes white, in others yellow, orange, red, etc. The fructification also took new forms on the different woods. A. L. S.

Monograph of Stereaceæ.—ALBERT PILÁT ("Monographie der europäischen Stereaceen," *Hedwigia*, 1930, **70**, 10-132, 3 pls., 1 text-fig.). Three genera of the Thelephoraceæ have been grouped by the author under Stereaceæ: these are *Stereum*, *Hymenochate*, and *Podoscypha*. After biological notes on their occurrence and their occasional pathogenicity, Pilát gives a long account of their morphology and anatomy. The family differs from the Corticiaceæ in the character of the trama and the presence of cystidia. He describes the various types of growth that

occur in *Stereum*, with special attention to the cystidia, their form and function, the latter of double service—to protect the hymenium from the bites of small animals and to avoid too great wetting of the surface. He also notes in some cases the presence of an "epithecium" which is of service in retarding too great evaporation. The setæ of the genus *Hymenochaete* are of similar service; they have the property of becoming intensely dark-coloured on the application of caustic potash. Another feature is the renewal in perennial species: a new hymenium is formed in *Stereum* from the previous year's hymenial layer. This formation is typical of *Stereum rugosum*, and 20 layers or more have been counted in that species. In *Hymenochaete* renewal the old hymenium tissue pushes up and forms new elements of fructification—basidia, setæ, etc. In the latter case an old specimen shows a basal cortical layer and trama with a very thick hymenial layer. The author then takes up the systematy of the family, with full accounts of *Stereum* (23 European species) and of *Hymenochaete* (8 species), with localities, citations, etc. A few species and forms new to science are described. A. L. S.

Study of Hyphal Tissue.—ILLO HEIN ("Studies on the Mycelium of *Psalliota campestris*," *Amer. Journ. Bot.*, 1930, **17**, 197–211, 2 pls.). Hein states, as the object of his study, the determination of the physical and chemical factors influencing the orientation, position and form transformations of the hyphæ of the common mushroom. With that aim in view, he has studied the tissues from spore germination onwards. He reviews all the possible factors, external and internal, that might affect the form and manner of development, both of the simple hyphæ and of the strands or "strings." In the latter there is little adhesion, and strand formation occurs more frequently in a moist than in a dry substratum. The gradual growth and enlargement of the strand has been followed, and the origin of the different elements of the tissues is described and their purpose suggested. Attention has also been given to branching, anastomosis, etc., to the occurrence of crystals of calcium oxalate and to the hemispherical pads on the end walls of the hyphal cells. It is suggested that these latter are masses of cell products in process of translocation, as a viscous liquid, from cell to cell. A. L. S.

Formation of Pseudoparenchyma.—ILLO HEIN ("The Tetrakaidecahedron in Pseudoparenchyma," *Bull. Torrey Bot. Club*, 1930, **57**, 59–62, 1 pl.). The author refers to work done on the shapes of pith cells, cork, etc., which enable them to fit closely together; he has carried the idea to the study of the pseudoparenchyma of fungi as exemplified in sclerotia. He finds there the same type of closely-fitting massed cells. He sums up that "the histogenetic processes in these structures involve a symphogenetic growth, which, through septation, interhyphal contacts and pressures, forms a tissue often identical in appearance with a true parenchyma of meristogenetic growth." A. L. S.

Soil Fungi.—E. L. LE CLERQ ("Cultural Studies of Some Soil Fungi," *Mycologia*, 1930, **22**, 186–210). The soil examined was taken from Colorado and has been isolated over a period of two years. A large number of fungi were dealt with, and their behaviour as to growth, etc., followed on a series of media. The cultural characters are tabulated for each species. A. L. S.

Soil Fungi.—JESSIE S. BAYLISS ELLIOTT ("The Soil Fungi of the Dovey Salt Marshes," *Ann. Appl. Biol.*, 1930, **17**, 284–305, 11 text-figs.). In this investigation, by means of artificial cultures of the soil, 48 species of fungi were isolated, 12 of which are new to Britain. The soil investigated is a badly aerated, stiff, tenacious clay, alkaline and with a high water-content due to periodical inundations

by tidal salt water. Three fungi, *Torula Allii*, *Penicillium hyphomycetis*, and *Fusarium oxysporium* var. *resupinatum*, were present in all the samples; a few others were almost equally common. Most of the species found were saprophytes; they seemed to be active only in association with organic material, and may have been introduced by drainage, etc. Two distinct associations—Glycerietum and Armerietum—yielded most of the fungi, and the same species of fungi were common to both. It was found that in *Armeria maritima* the rhizomes and roots contained very little lignified tissue; the tall roots were hollow tubes, the substance having been destroyed by fungi and bacteria.

A. L. S.

New or Noteworthy Fungi.—W. B. GROVE (*Journ. Bot.*, 1930, 68, 131–4, with text-figs.). Grove publishes a further instalment of microscopic fungi, mostly collected in the central counties of England. Several genera new to Britain are included in the list.

A. L. S.

Fungi of Venezuela.—H. SYDOW ("Fungi venezuelani," *Ann. Mycol.*, 1930, 28, 29–224). The author here records the results of a two months' visit to Venezuela. He indicates seven localities where his collections were made. The list includes species of nearly all sections of fungi, but those best represented are microfungi—the Uredineæ, the Ascomycetes, and the Fungi Imperfecti. A very large number of new species are described under many different genera, and new genera are diagnosed, especially in the Ascomycetes: they are *Malacarea* (growing with *Meliola*), *Xenostomella*, *Ellimonina*, *Actinosoma*, *Dialaxenium*, *Antimanoa* and *Tovariella*, with two genera of Hyphomycetes, *Oedothea* and *Stenelli*. A very large proportion of these smaller fungi were parasitic on leaves. The new species are described at great length.

A. L. S.

Physiology of Parasitism.—R. SAHAI VASUDEVA ("Studies in the Physiology of Parasitism. XI. An Analysis of the Factors Underlying Specialisation of Parasitism, with Special Reference to the Fungi *Botrytis Allii* Munn and *Monilia fructigena* Pers.," *Ann. Bot.*, 1930, 44, 469–93). The factors responsible for the failure of *Monilia fructigena* to attack onion and of *Botrytis Allii* to attack apple have been studied in various ways. In the case of *Monilia* there is a "thermolabile" substance in the onion which can be extracted with chloroform or ether—a substance which is found to retard fungal growth generally, though *Monilia* spores are more sensitive to it than spores of *Botrytis Allii*. It was further proved that, in certain conditions, *B. Allii* can produce a pectinose enzyme which destroys apple cell-wall substance, and this fungus can parasitise apple tissue if some nitrogenous substance is added to the inoculum. The effect on the apple is described. Apples artificially ripened by exposure to high temperature are rendered susceptible to attack by the *Botrytis*, other factors being involved in disease resistance or susceptibility.

A. L. S.

Congo Fungi.—M. BEELI ("Notes mycologiques. IV. Contributions à la flore mycologique du Congo," *Bull. Jard. Bot. État Bruxelles*, 1930, 8, 245–60, 1 pl.). The fungi enumerated were collected from various localities in the Congo during the last twenty-two years. They are mostly *Polyporeæ*, and form an important contribution to a mycological flora of tropical Africa. The author notes the difficulty of being certain as to determinations, and deprecates the lack of concise information with regard to habitat, etc. He has determined nine species of *Polyporaceæ* new to science and two species of *Agaricaceæ*. One Ascomycete, *Daldinia concentrica*, was also found.

A. L. S.

Violet Rays and Sporulation.—G. B. RAMSEY and ALICE ALLEN BAILEY ("Effects of Ultra-violet Radiation upon Sporulation in *Macrosporium* and *Fusarium*," *Bot. Gaz.*, 1930, **89**, 113–36, 1 pl., 12 text-figs.). Difficulty in obtaining spores in artificial cultures of *Macrosporium* for taxonomic study was experienced by the writers, also in *Fusarium*, under the same conditions, when microspores were produced in abundance, but no macrospores. Recourse was had to the influence of light, which was tested when all other methods had failed. The response was immediate. A definite stimulation of spore production was observed in *Macrosporium tomati* and *Fusarium Cepæ* on exposure to radiation produced by a quartz mercury, etc. Details are given as to the units most favourable, and as to the time required for the highest activity. The authors also proved definitely that the stimulation effect was not due to any influence on the medium nor to temperature. Long exposure to direct sunlight in May also induced abundant sporulation in both types of fungi. A. L. S.

Physiology of Parasitism.—G. NICOLAS ("Sur la transpiration des plantes parasitées par des champignons," *Rev. Gén. Bot.*, 1930, **42**, 257–71). Nicolas gives the results as to the effects on transpiration of the host due to fungal parasites. A number of hosts were selected for study. Results arrived at by previous workers are given. Nicolas tabulates the results of his own experiments. In general he finds that the parasitised portions of the plant have a higher transpiration than the healthy areas. He noted, however, two exceptions, *Plasmopara viticolor* and *Puccinia fusca*, the latter on *Anemone nemorosa*. The harmful effects of this extreme transpiration are noted, and are evidence of the disturbing and destructive action of fungi in altering the gaseous exchange of the host tissues. A. L. S.

Metabolism in Fungi.—E. H. M. FARRIES and A. F. BELL ("On the Metabolism of *Nematospora Gossypii* and Related Fungi, with Special Reference to the Source of Nitrogen," *Ann. Bot.*, 1930, **44**, 423–55). The research arose from the necessity of using the most suitable media for culture experiments. Many cultures were made, and certain results were arrived at. The fungi tested had no power of fermenting sugary liquids, thus differing from yeasts. They did not grow on nitrogen from asparagin, but developed freely on peptone or lemco. The character of the nitrogenous molecule most advantageous is discussed, and the behaviour of the fungus with regard to different preparations of the nitrogen, such as hydrolysed gelatin, white of egg, etc. The growth-promoting substance has been studied chemically, and it is suggested that it may be an organic acid. A. L. S.

Saltation in Fungi.—S. N. DAS GUPTA ("Studies in the Genera *Cytosporina*, *Phomopsis*, and *Diaporthe*. II. On the Occurrence of Saltation in *Cytosporina* and *Diaporthe*," *Ann. Bot.*, 1930, **44**, 349–84, 2 pls., 9 text-figs.). The species studied was isolated from 50 different specimens of Lane's Prince Albert apples, and has been listed as *Cytosporina ludibunda*. Numerous cultures were made and many saltants were observed. By far the greater number were obtained from pycnospores, and different saltants occurred from one and the same pycnidium. These saltants are described. The majority are of *Phomopsis* type, and on comparison with species of *Phomopsis* their similarity has been established. There were also comparisons made with strains of *Diaporthe perniciosa*. A. L. S.

Insects as Disease Carriers.—ANNA E. JENKINS ("Insects as Possible Carriers of the *Citrus* Scab Fungus," *Phytopathology*, 1930, **20**, 345–51, 2 text-figs.). The writer has observed insects feeding on the *Citrus* scab fungus, and in the faeces

of these insects have been found the spores of the fungus. These were tested by cultures, and developed the fungus, thus justifying the view that the insect disseminated the disease.
A. L. S.

Mushroom Disease.—D. E. GREEN ("Diseases in the Mushroom Bed," *Gard. Chron.*, 1930, **87**, 516-17, 3 text-figs.). There are two types of unwanted fungi in the mushroom bed—those that attack the mushroom and those that grow through the compost and use up the food material. Green describes two fungi. The first, a white fungus, *Mycogone perniciosa*, appears on the bed when mushrooms should be reaching maturity. Instead of mushrooms there are developed distorted whitish masses, with the fructification of the *Mycogone* spreading over the surface. The second fungus, *Xylaria vaporaria*, is saprophytic on the compost; it forms dark-coloured sclerotia, on which are developed later the fructifications.
A. L. S.

Notes on Cycloconium.—G. NICOLAS and Mlle. AGGÉRY ("Remarques sur *Cycloconium Phillyreae* Nicol. et Agg.," *Bull. Soc. Mycol., France*, 1930, **45**, 295-6). This parasite attacks the leaves, which become quickly yellow and fall to the ground. It is localised in the cuticle, and has not been detected in the other tissues. The authors conclude that the fungus is disseminated by the conidia of the Hyphomycete.
A. L. S.

Notes on Stagonospora.—G. NICOLAS and Mlle. AGGÉRY ("Observations sur *Stagonospora Crini* Bubak & Kabat," *tom. cit.*, 297-9, 2 text-figs.). Though at first described as a saprophyte on dead leaves, the authors find cause to consider *Stagonospora Crini* a parasite. On the upper surface of the leaves appear blood-red spots which penetrate the whole leaf. In these coloured portions a septate mycelium is present, and pycnidia are developed on the attacked portions. *Crinum* leaves are occupied by large lacunæ, and, owing to the influence of the parasite, the cells neighbouring the lacunæ grow out into the spaces until these are filled. It is conjectured that the colouring matter is due to bacteria which penetrate along with the fungus.
A. L. S.

Disease of Date Palms.—HOWARD S. FAWCETT ("An Offshoot and Leaf-Stalk Disease of Date Palms due to *Diplodia*," *Phytopathology*, 1930, **20**, 339-44, 2 text-figs.). The *Diplodia* found in the diseased tissue of the palms is similar in size of spores to *D. natalensis*, that produces stem-end rot and gummosis in *Citrus*, but it is probably not identical with that fungus. It particularly attacks offshoots, either destroying the outer leaves or causing a die-back of the buds. The effect on the palm is described, and the various experiments with cultures and inoculations. These leave no doubt that the *Diplodia* is the cause of the disease. It is more or less a wound infection, and not only cut surfaces, but tools should be disinfected. Spraying also is recommended.
A. L. S.

Dry Rot of Corn.—A. H. EDDINS ("Dry Rot of Corn caused by *Diplodia macrospora* Earle," *Phytopathology*, 1930, **20**, 439-48, 3 text-figs.). The fungus attacks leaves and stalks, but more especially the ears of the maize, the white mycelium appearing between the kernels. Pycnidia may occur on the sides and the tips of kernels and on the husks. Several other species attack maize, but *D. macrospora* is distinct in the large size of the spores. The organism enters through exposed tips and wounds. It hibernates as dormant mycelium in the seed, in old plant debris, and in the soil. Experiments were carried out as regards temperature and the best culture media.
A. L. S.

Anthracnose of Snowberry.—ANNA E. JENKINS (" *Sphaceloma Symphoricarpi*," *Mycologia*, 1930, **22**, 106–10, 2 pls.). The fungus attacks the leaves of the Snowberry, and has been frequently discussed. The writer has described the attack, and the gradual development of the parasite on the upper surface of the leaves, where acervuli are formed with conidiophores. A. L. S.

Cherry Leaf-Spot Fungus.—W. A. JENKINS ("The Cherry Leaf-Spot Fungus, *Mycosphaella Cerasella* Aderh., its Morphology and Life-History," *Phytopathology*, 1930, **20**, 329–37, 2 text-figs.). The author has correlated the various stages of fruit development in this fungus. It forms small spots on either surface of the leaves. In severe cases serious defoliation results. The first formation is of stromatic tissue from which arise conidiophores with brown 1-septate conidia. Later, minute "spermogonia" are formed on both leaf surfaces, and along with them arise the perithecia of the perfect fruiting stage, the development of which was carefully followed. A coiled cœnocytic carpogonium arises near the base of the stroma and projects nearly or entirely through the cells at the apex by means of a trichogyne, which degenerates later. Ascogenous hyphæ arise, each one becoming an ascus. A pair of nuclei migrate from the ascogonium and fuse to form the primary fusion nucleus of the ascus. A. L. S.

Lichens.

Cladoniæ of the Gaspé Peninsula.—ARTHUR F. ALLEN ("Some Cladoniæ from the Valley of the Gaspé Peninsula, Quebec," *Rhodora*, 1930, **32**, 91–4, 1 pl.). The paper is a supplement to previous lists by C. W. Dodge, supplying as it does new forms and stations and also new records and species. Most of the species recorded have a very wide distribution, as, for instance, *Cladonia borbonica*, which has been recorded from Australia, Java, the islands of Bourbon, Mauritius, and Madagascar, as well as from South America. *Cl. invisæ* Robbins, a new species, is described, somewhat resembling *Cl. cœspiticia*. A. L. S.

Abyssinian Lichens.—EVA MAMELI-CALVINO ("Pugillo di licheni dell' Abissinia e dell' Eritrea," *Nuovo Giorn. Bot. Ital.*, 1930, **37**, 255–8). The lichens enumerated were collected at different times by several explorers in North and Central Abyssinia and in Eritrea. Some 40 species and varieties have been determined by Mameli-Calvino. All are new to Abyssinia, some are new also to Africa. They are all European species, most of them well-known forms. A. L. S.

Lichens of the Volga and the Ural.—BORIS KELLER ("Die Erdflechten und Cyanophyceen am untern Lauf der Wolga und des Ural," *Vegetationsbilder*, 1930, **20**, 8, pls. 43–8). The series of plates with letterpress give an account of several lichens that grow in great abundance on rocks or soil in the lower valleys of the Volga and Ural Rivers. In those semi-desert associations 44 lichen species have been found—not all of them confined to warm desert land—*Psora decipiens* is cited as growing on hot dry rocks and also in Nova Zembla. Several of the plants are endemic to the region. In many of these districts there is soluble salt in the soil, and Keller suggests that plants such as *Teloschistes brevior* var. *halophila* are true halophytes. Plate 43 depicts *Aspicilia esculenta* (the supposed manna lichen) growing in association with flowering plants. Plate 44 represents its abundant growth on clay soil, whence it is easily detached by the wind and becomes an erratic lichen. Plates 44 and 45 give other aspects of the lichen under other names, *A. affinis*, *A. desertorum*, etc. The other plates depict *Parmelia vagans*, also an erratic lichen, with associated higher plants; also lichen growths

with a considerable admixture of Cyanophyceæ; finally associations including *Psora decipiens* and *Acarospora Schleicheri* along with *Nostoc*, mosses, etc.

A. L. S.

Mexican Lichens.—BOULY DE LESDAIN ("Lichens du Mexique. Lichens recueilles par le Frère Amable St. Pierre," *Ann. Crypt. exotique*, 1929, 2, 217-54). Frère Amable, who collected the lichens, gives a short account of the country and of the lichen distribution. Most of the specimens were collected in the "Mexican Valley": the district includes forests and mountains. He specially notes a spur of the Sierra da Guadalupe, where the lichens covered huge blocks of siliceous rock. The altitudes of the different localities are also given, extending up to 3,000 m., and almost everywhere there were dense lichen growths. A considerable number of new species were found and mostly determined by the author. The *Acarosporæ* were submitted to H. Magnusson, and eight new species are described. A complete index of species of this and of a previous memoir is added, as also a list of fungi parasitic on the lichens.

A. L. S.

Silesian Lichens.—JÓZEF MOTYKA ("Materiaux pour la connaissance des Lichens de Silesie," *Wydawnictwa Muzeum Slaskiego W Katowicach*, 1930, 3, u. 2, 1-28, 3 pls., Polish with French résumé). The writer gives a description of the region explored—"the Beskides of Silesia," hills that reach a height of 1,214 m. and are covered with forests. The principal trees are oak, lime, ash, poplar, etc. On these trees the lichens are somewhat rare. A definite flora was found on the alders by the rivers. Agriculture has destroyed many lichens, but remains of beech forests still exist, and lichens are there in profusion. As *Usneæ* were particularly abundant, special attention was given to them, and an analytical key to the species occurring in the region is given, and figures are produced on the plates.

A. L. S.

Lichen Vegetation of Poland.—R. KOBENDZA and J. MOTYKA ("La végétation des éboulis des Monts de Ste. Croix," *Bull. Acad. Pol. Sci. Lettr. Cl. Sci. Math. et Nat.*, 1929, 175-207, 6 pls.). The paper gives the results of an expedition to Poland and Czecho-Slovakia in 1928, with a special examination of the "éboulis," the piles of rock debris that were encountered in zones either on the slopes or near the summits of the hills. A section of the work, by Kobendza, deals with Cryptogams in general, and a *Cladonietum* was observed close to the forests, but well exposed to sunlight and wind. Seventeen species are recorded, among the rarities *Cladonia alpestris*. The special lichen section, by Motyka, concerns the epilithic lichens growing on the massed stones, mostly siliceous. An interesting association is described from the summit, consisting of species not otherwise found in Central Poland—*Gyrophoræ*, *Parmeliæ*, and others, with a number of the commoner *Cladoniæ*. The association is compared with the lichens of the Tatra, and their dispersal and arrival are discussed at length. As most of the lichens were non-sorediate, and the possibility of dissemination by spores is remote—some of them failing to form fructifications (notably *Gyrophora polyphylla* and *Cladonia alpestris*)—Motyka concludes that dispersal must be by thalline fragmentation. He also discusses the probable age of these lichen colonies, and concludes that they date back to glacial times and to the retreat of the ice. He finds that similar high mountain species occur in the Harz and the Sudètes, and it might be possible that these mountains were nunataks. It has been decided that certain lichen stations in Pomerania, Lettonia, and Esthonia date from the last glacial period, and that possibly the lichens of the "éboulis" belong also to that era. It is not considered that the question is as yet satisfactorily answered.

A. L. S.

Distribution of Lichina.—GLADYS L. NAYLOR ("Note on the Distribution of *Lichina confinis* and *L. pygæa* in the Plymouth District," *Journ. Marine Biol. Ass., United Kingdom*, 1930, **16**, 909–18, 1 text-fig.). Both species of *Lichina* were found to be abundant on the coast near to Plymouth, *L. confinis* being the more generally distributed, but in areas that receive little spray it is more or less absent. *L. pygæa* was abundant on rocks with steeply inclined faces and on somewhat rough surfaces, and the growth is favoured by breaking waves; it is scanty along the sheltered parts of the Sound. The effect of light seems to be secondary. Naylor discusses the probability that the air-bubbles in the breaking waves may be a factor of influence in the occurrence of *L. pygæa*. It is generally abundantly fruited.

A. L. S.

Study of Chlorocyphella.—EVA MAMELI-CALVINO ("Ricerche su una forma singolare di deuterolichene *Chlorocyphella subtropica* Speg.," *Nuovo Giorn. Bot. Ital.*, 1930, **37**, 369–79, 1 pl.). The epiphytic plant here described was published originally as a Hymenolichen by Spegazzini in 1909. Mameli-Calvino has again examined specimens from Cuba and Brazil, and she has described it with great care, comparing it with another species, *Ch. æruginascens*, published by Keissler and others as a fungus. The symbiotic alga is evidently a *Cystococcus* sp. The fructification is open and cup-like and shortly pedicellate; the spores (scoleo-spore) are borne on filiform unicellular pseudobasidia. It is thus neither an Ascomycete nor a Hymenomycete. Mameli-Calvino proposes a new class of Deuterolichenes, with, so far, the one genus *Chlorocyphella* and two species, *Ch. æruginascens* and *Ch. subtropica*. Both species are from South America, the latter also from Cuba.

A. L. S.

TECHNICAL MICROSCOPY.

The Origin of a Reflex Micrograph.—J. V. RAMSDEN. During the course of a lengthy investigation into the size of the particles of certain powders, and the behaviour of the grinding machinery which produce them, I had constantly to use a microscope. I found that the ordinary instrument was particularly inconvenient, as the powders were best examined after being floated in water. An inverted microscope was clearly indicated, but, after searching many lists, I could find nothing which seemed likely to fill my requirements. I therefore set out to construct an instrument for myself, and drew up the following specification:—

- (1) The field must be visible to two or more observers, in order that they may discuss the phenomena seen.
- (2) All controls must be extremely convenient, so that adjustments can be made while watching the field.
- (3) It must be possible to place the instrument in the hands of untrained workers, so that it can be used for routine inspections.
- (4) Photographs must be taken with the utmost ease.
- (5) Each photograph must carry its own description impressed on the plate when it is exposed.
- (6) Both plain and polarised light, as well as vertical illumination, must be available.

The original instrument has now been in daily use for three years, and has answered its purpose most admirably.

It consists of an inverted microscope over a stainless steel mirror, which throws the picture upwards on to a conveniently-placed ground glass, close to and below the stage level. Just below the main picture on the ground glass is a secondary picture of any written label which the operator may wish to impress on the negative. This is thrown by a separate lens and camera, the object being also illuminated by a separate electric lamp. In a shallow recess just below the ground glass is placed a divided glass scale, which is almost touching the ground glass or photographic plate. Therefore its shadow is clearly seen in the field of the main picture, and particles can be measured instantly, while their actual size is also recorded on the photographs.

The photograph therefore shows : (1) the object itself ; (2) its measurements ; (3) any description or number which the operator may wish to record on it.

In practice this latter record is of the utmost convenience when searching through a large number of records.

Recently the whole instrument has been redesigned by Messrs. Watson, of 313, Holborn, London, with a view to embodying all the original requirements in a commercially-producible instrument which will be available for all purposes.

A New Microscope Hot Stage.—I. AMDUR and E. V. HJORT (*Ind. Eng. Chem. (Anal. Edit.)*, 1930, 259-260). A hot stage is described and illustrated by which melting-point determinations can be made with the same degree of accuracy as by the capillary tube method. It consists of a brass block, which takes the place of the ordinary rotating stage, fitted with thermometer holes and two No. 24 chromel wire resistance coils encased in pyrex glass tubes, which can be heated singly or in series. The block is bored with a 9 mm. hole to take the micro-electric cell, and the centre of the block bored vertically with a hole 19 mm. wide at the upper half and 6 mm. wide at the lower half. Upon the shelf so formed is placed the pyrex sample holder. Prior to making actual determinations of unknown substances, melting-points should be taken of highly-purified substances in order to calibrate the stage. Polarised light can be used in the case of anisotropic substances. This hot stage can also be used for the determination of molecular weights by a modification of the Rast method. A. H.

Microscopical Methods in Analytical Chemistry.—C. W. MASON (*Ind. Eng. Chem. (Anal. Edit.)*, 1930, 2, 203-6). A general paper emphasising the value of the microscope for both qualitative and quantitative analytical work, as well as for supplementing results obtained by ordinary analytical methods, while information can be gained which is not revealed by chemical analysis. Mixtures are more readily identified, and a separation can frequently be effected of quantities large enough for microchemical tests. As an example of the use of microscopical analytical methods, the author quotes—with an illustration—the determination of a mixture of rice and potato starches. A. H.

Photographic Estimation of Foreign Materials in Gums and Resins.—E. A. GEORGI (*Ind. Eng. Chem. (Anal. Edit.)*, 1930, 2, 331-4). A sample of the resin, freed from external layer, is carefully melted in a flat-bottomed crystallising dish until a layer 4-5 mm. is obtained, and the solidified layer photographed in both transmitted light and dark-ground illumination. The results obtained from the examination of eight samples by the A.S.T.M. method (insolubility in toluene) and by the photographic method are given and compared. It is shown that the latter method affords a quick, accurate, and economical means of estimating the insoluble impurities present, and possesses the additional feature of determining

the relative sizes of the particles as well as their general characters. Uniformity in the preparation and photographing of the films is essential if strictly comparable pictures are desired.

A. H.

Some Histological Studies of the Effects of Grubs upon Animal Skin.—

F. O'FLAHERTY and G. D. McLAUGHIN (*Journ. American Leather Chem. Assoc.*, 1930, **25**, 266–70). The authors describe the life-cycle of the grub-fly (i.e., *Hypoderma lineatum* and *H. bovis*). The eggs are deposited on the hair near the heel, the larvæ then entering the skin through the hair follicle, etc. The grub then enters the corium and next appears in the region of the animal's back, during which period it undergoes a number of moults. The paper is illustrated by 29 microphotographs showing the formation of the grub spaces and breathing channels or pores. If the warble-fly escapes from the hide prior to slaughter, Nature attempts to repair the damage done by the formation of scar tissue. The fibres of this tissue are unidirectional, and hence their weakness as compared with the polydirectional structure of the corium proper.

A. H.

New Model Vickers Projection Microscope.—The Vickers Projection Microscope has been designed on entirely unconventional lines, the main object being to produce an instrument which is immensely robust, immune from vibration, and at the same time more convenient to manipulate than microscopes and metallographs generally.

The first model was designed by Mr. R. L. Smith, of Vickers Limited, in the year 1922. The basic principles were found, by practical experience, to be completely sound and successful, but during the years that have elapsed since the first model was made, a considerable amount of time and attention has been devoted to perfecting the design and introducing refinements, with a view to increasing the usefulness of the instrument generally.

The new model, which has just been produced, is illustrated diagrammatically in figs. 1 and 2. The microscope block M consists essentially of a very heavy casting, bored, as required, for the introduction of the microscope tube T, the illuminator tube L, the diaphragm and small condenser tube D, and the visual tube V.

The microscope tube T carries an objective at its upper end and an eyepiece in special adaptor at its lower end. The upper end of this microscope tube is machined externally with a very fine thread, and engaging with this thread is a large nut N. The weight of the microscope tube T and its fittings is taken by the underside of the nut N resting on the top face of the microscope block M. The fine focusing movement is effected by rotating the nut N.

The revolving and traversing stage S is mounted on a heavy cast-iron support SS. This stage support can be raised or lowered by a rack-and-pinion motion. The vertical portion of this casting surrounds almost half of the block M, and a powerful clamping spring can be applied by partially rotating the clamping screw lever C.

Fig. 3 illustrates in plan the principle of the stage elevating movement. The stage support SS is fitted with vertical sliding faces F 1, F 2, which engage with similar sliding faces on the microscope block itself. When the required elevation of the stage is attained, the clamping screw lever C forces the sliding faces together, under the influence of the large clamping spring SP. By this means the stage is supported very firmly, close up to and on either side of the objective, thereby eliminating one of the most dangerous sources of vibration.

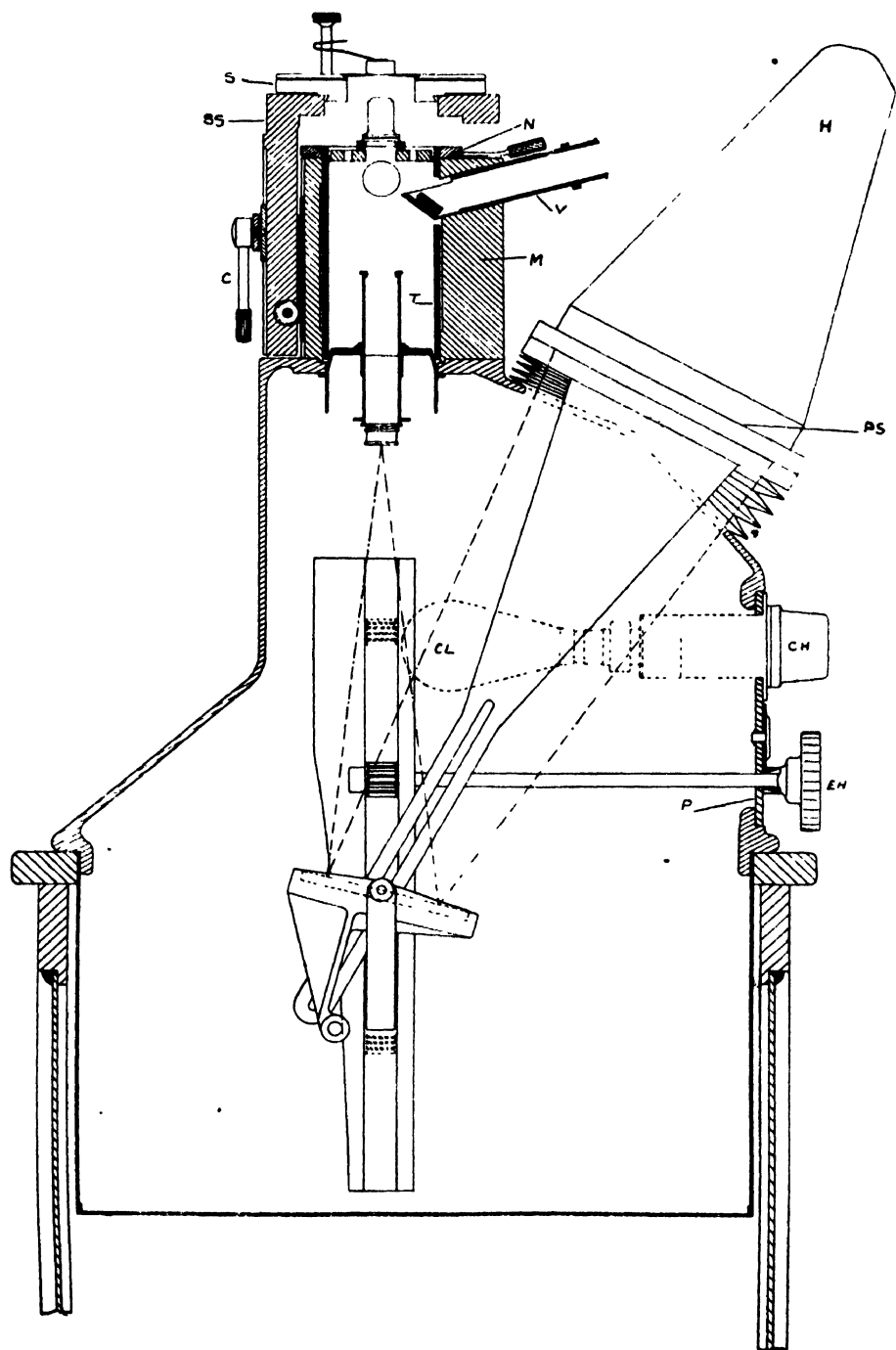


FIG. 1.

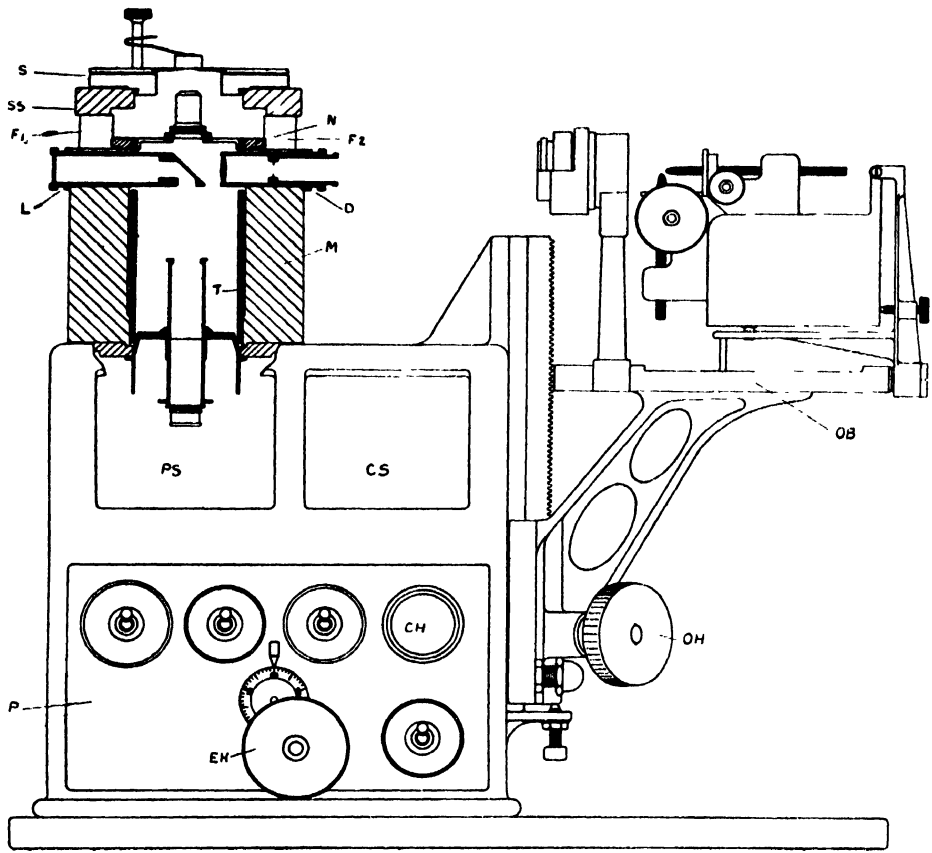
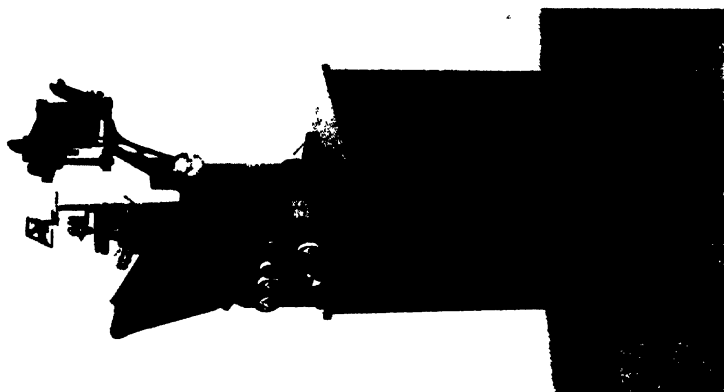


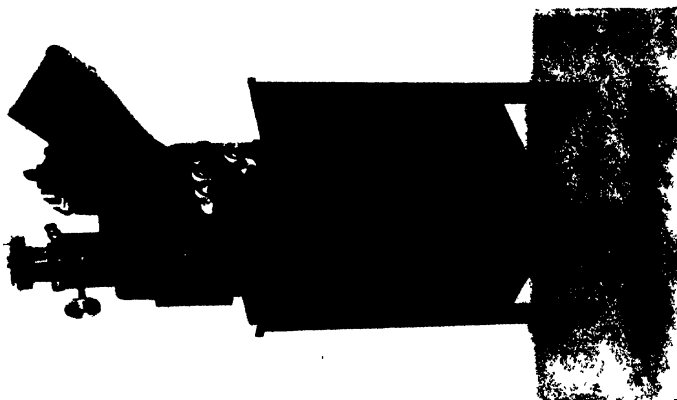
FIG. 2.



Fig



F



Fig

Objects, from the very lightest to those weighing about 50 lbs., can be supported on this stage without vibration or fear of damage to the microscope.

The whole microscope, as described above, is mounted and bolted down upon a heavy cast-iron camera case. The camera extension handle EH controls the mechanism which elevates a rustless steel mirror, as required, tilting same automatically, together with the projection screen PS, to suit. The effect of this is that the operator, who is viewing the screen through the top of hood H, can adjust the camera length as required, without leaving the desirable proximity of the microscope and of its controls.

The whole metallographic unit is so robust and compact that it is immune from differential vibration of its various components. The rigidity of the supporting

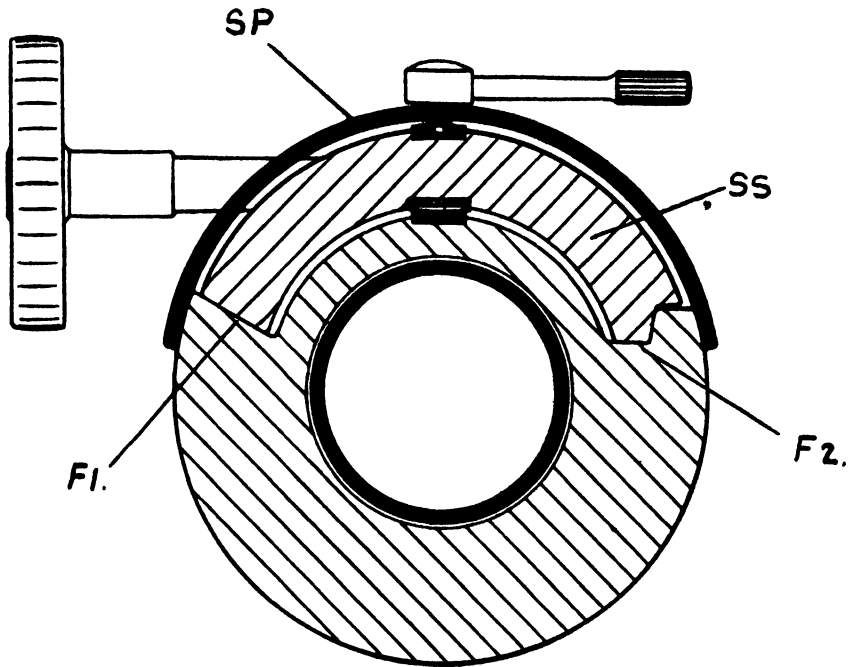


FIG. 3.

cabinet CB, or the foundations upon which the latter stands, is therefore of no consequence so far as vibration is concerned.

It has been found that this apparatus is so indifferent to external vibrations that excellent photomicrographs may be obtained at a thousand diameters magnification, with a train service and steam hammer operating near-by.

The optical bench OB carries, in addition to the water-trough, condenser, etc., a clockwork arc lamp and a pointolite lamp on a swivel support. This arrangement permits either type of illumination being available at a moment's notice. A dimming device for the pointolite is fitted for visual examinations.

All optical units can be raised by the rack-and-pinion motion controlled by the handle OH. This movement is particularly convenient for macro work or when examining objects by transmitted light (see figs. 5 and 6).

On the right-hand side of the camera is a comparison chamber, illuminated

by a special lamp CL. This comparison chamber serves to illuminate any photomicro transparencies that may be placed on the comparison screen CS. This comparison device is particularly convenient when it is desired to compare the microstructure of a specimen with that of a standard material, as it permits of very rapid and accurate inspection. It is also extremely useful for demonstrating purposes. The intensity of illumination for the photomicro transparencies on screen CS can be adjusted by means of the handle CH, to balance the illumination of the projected specimen on screen PS.

The entire electrical controls and camera extension control are mounted on the panel P.

The centring mounts for the objectives are magnetic, and this enables them to be secured very firmly and readily in a magnet-holder which is fitted to the upper end of the microscope tube.

The stage is fitted with a stop which determines the approximate focusing position, and prevents any possibility of damaging objectives or specimens by bringing them in contact.

The Vickers Projection Microscope is available for use at magnifications ranging from 4 diameters to 5,000 diameters.

NOTICES OF NEW BOOKS.

The Development of Sex in Vertebrates.—By F. W. ROGERS BRAMBELL, B.A., Ph.D., D.Sc. 1930. xvi + 261 pp., 24 plates, 25 text-figs. Published by Sidgwick & Jackson, Ltd., 44, Museum Street, London, W.C.1. Price 12s. net.

Recent Advances in Chemotherapy.—By G. M. FINDLAY, O.B.E., M.D., D.Sc. 1930. viii + 532 pp., 4 plates, 11 text-figs. Published by J. & A. Churchill, 40, Gloucester Place, London, W.1. Price 15s. net.

Histological and Illustrative Methods for Entomologists.—By H. ELTRINGHAM, M.A., D.Sc., F.R.S. 1930. xii + 139 pp., 1 plate, 21 text-figs. Published by Mr. Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 7s. 6d. net.

The Oedogoniaceæ.—A Monograph including all the Known Species of the Genera *Bulbochæte*, *Edocladium*, and *Edogonium*.—By L. H. TIFFANY, M.Sc., Ph.D. 1930. 256 pp., 64 plates, 647 figs. Published by the Author, The Ohio State University, Columbus, Ohio, U.S.A. Price: cloth \$5.00; paper \$4.00.

PROCEEDINGS OF THE SOCIETY.

A SPECIAL MEETING

OF THE SOCIETY WAS HELD IN THE GREAT HALL, KING'S COLLEGE, LONDON, W.C. 2,
ON MAY 21ST, 1930, PROF. R. RUGGLES GATES, M.A., Ph.D., PRESIDENT,
IN THE CHAIR.

The President announced that the Society had the honour of receiving that evening Prof. Nils E. Svedelius, of Upsala, whom he called upon to read a paper on "The So-called Freshwater Lithoderma."

At the conclusion of the foregoing communication the President proposed that a hearty vote of thanks be accorded to Prof. Svedelius for his paper, which was carried with acclamation.

The President then called upon Prof. C. H. Desch, D.Sc., Ph.D., F.R.S., to take the Chair.

Prof. Desch, in responding, announced that the meeting had been called for the special purpose of considering recent advances in current research and practice in microscopic metallography, and complimented the Society on the comprehensive exhibition of instruments and apparatus which was being held in connection therewith.

Papers.—The following communication was then read:—

Mr. Conrad Beck, C.B.E., F.R.M.S.—

"The Illumination of Metallurgical Specimens."

In the discussion that followed, Dr. W. Rosenhain heartily agreed with Mr. Beck that the problem of illuminating metallurgical specimens had not received the attention it deserved. He disagreed with him, however, as to the merits of the method suggested in the paper, and pointed out that the theoretical considerations implied are not realised in practice when examining the structure of metallurgical surfaces by the clear glass disc reflector method, this being particularly bad as regards glare, which seriously affects definition. It is an error to consider the surface of a metallurgical specimen as a mirror surface, which it ceases to be when etched, as most specimens are for examination. He had come to the conclusion that a great deal of the glare is due to the reflecting surfaces of the object-glass itself, and suggested that these reflecting surfaces of the lens might be utilised for the examination of the specimen. He asked whether the lens could not be so designed as to reflect a portion of the incoming light downwards and the remaining portion upwards, thus making the lens its own illuminator.

Prof. A. W. Porter suggested the utilisation of a small circular reflector in the centre of the lens.

Prof. C. H. Desch confirmed the advantage of interposing a nickel prism as a means of getting rid of glare.

Mr. S. C. Akehurst suggested the partial silvering of the back surface of the front lens of the objective as a means of increasing illumination without loss of resolution.

Mr. Beck, in reply to Prof. Porter, said that a small circular reflector in the centre of the lens turns out in practice to be about the worst form one can have, because the definition of the object-glass is, as a rule, very badly destroyed. He said that there was, however, a considerable amount of work to be done in the matter of these small illuminators.

He greatly appreciated Dr. Rosenhain's observations from his practical experience, which were of very great value.

A question was asked as to whether he had considered the utilisation of a collodion film as a vertical illuminator in place of the thin glass plate. A collodion film, it was observed, is optically perfect, and by such a method definitely superior results are obtained. Mr. Beck thought it should be an extremely good method, but he regretted to say that his own attempts at preparing these films had not been good.

The following communications were then read and discussed :—

Dr. W. Rosenhain, D.Sc., F.R.S., and Mr. A. J. Murphy—

“Technique for the Microscopic Examination of the Structure of Metals and Alloys of Mercury.”

Mr. R. L. Smith, B.Sc.—

- (1) “A New Projection Microscope for Metallography.”
- (2) “A Modified Ramsden Eyepiece for Hardness Testing.”

Dr. W. H. Hatfield, D.Sc.—

- (1) “The Application of the Microscope to the Examination of Stainless, Acid and Heat-Resisting Steels.”
- (2) “The Firth Hardometer.”
- (3) “The ‘Borescope.’”

(Communicated by Mr. G. Stanfield.)

On the motion of the Chairman, a very cordial vote of thanks was accorded to the authors of the foregoing communications, and to the exhibitors who had contributed so largely to the success and value of the meeting.

At the request of the Chairman, Dr. Tierney then announced that the Rooms of the Society would be closed for the Summer Vacation from August 18th to September 13th, 1930, and that the next Ordinary Meeting of the Society would be held on Wednesday, October 15th next, at 5.30 p.m., in the Hastings Hall at the Society's new premises, British Medical Association House, Tavistock Square, Bloomsbury, W.C. 1.

On the motion of the President, a cordial vote of thanks was unanimously accorded to Prof. Desch for kindly presiding at the meeting.

The proceedings then terminated.

The following is a list of exhibits :—

<i>Exhibitors.</i>	<i>Description.</i>
R. & J. Beck, Ltd. . . .	Hadfield-Beck micro-metallographic apparatus, etc.
Brown-Firth Research Laboratories.	Specimens and photomicrographs of stainless, acid and heat-resisting steels, Firth Hardometer, and "Borescope."
Hadfields, Ltd. . . .	Series of micro-metallographs taken with the Hadfield-Beck apparatus.
Chas. Hearson & Co., Ltd. . . .	Reichert large metallographic microscope, EM/1.
Adam Hilger, Ltd. . . .	Spectrographic apparatus for the spectroscopic testing of metals.
E. Leitz (London)	Large new and re-designed metallographic apparatus. Material testing microscope. New types of grinding and polishing machines. Large new type metallurgical microscope. Photomicrographic cameras, etc.
National Physical Laboratory	Exhibit of some recent work on the microscopic examination of the structure of metals and alloys of mercury.
Lt.-Col. J. V. Ramsden, C.M.G. . . .	Reflex micrograph.
Research Department, Woolwich. . . .	Series of micro-metallographs.
James Swift & Son, Ltd. . . .	Jackson-Blount and other metallurgical microscopes and photomicrographic camera, etc.
Vickers-Armstrongs, Ltd. . . .	New model projection microscope. Pyramid hardness testing machine. Series of microphoto transparencies.
W. Watson & Sons, Ltd. . . .	Metallograph. Metallurgical microscopes. "Vernier" microscope. Photomicrographic cameras. Grinding and polishing machine, etc.
Carl Zeiss (London), Ltd. . . .	Large micro-metallographic apparatus. Small micro-metallographic apparatus. Metallographic Microscope SCE (new model). Rock and crystal grinding machine, etc.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1930.

TRANSACTIONS OF THE SOCIETY.

XVIII.—PHENOMENA OF HETEROTYPIC DIVISION IN THE
POLLEN MOTHER-CELLS OF A TETRAPLOID FORM OF *RUMEX*
SCUTATUS VAR. *TYPICUS*.*

By M. A. FIKRY.

(Read November 19, 1930.)

SIX PLATES.

INTRODUCTION.

THE present work is a study of the first meiotic division in a tetraploid form of *Rumex scutatus*. Chromosome counts on this species were made by Roth as early as 1906. Roth found 12 as the haploid number of chromosomes. Noda (1926) and Kihara and Ono (1926) counted the chromosome number in the pollen mother-cells, and gave 10 as the haploid number. Jaretsky (1928), working on the root-tips of *Rumex scutatus* var. *glaucus*, confirms Noda's and Kihara's findings. The present investigation gives 20 as the haploid number of *R. scutatus* var. *typicus*, and if 10, the number found by Noda, Kihara, and Ono, and confirmed by Jaretsky, be the correct one, the plants on which this work has been carried out are therefore tetraploid.

Polyploidy has already been demonstrated in the genus *Rumex*, thanks to the work of Kihara and Ono and of Jaretsky. The fundamental haploid number of chromosomes in the section *Lapathum* was found to be 10, e.g., in *R. alpinus* and *R. salicifolius*, while species with 20, 30, 40, 50, 60

* Thesis approved for the degree of Doctor of Philosophy in the University of London.

and 100 chromosomes (haploid number) were also found. These polyploids are, according to Kihara and Ono, allopolyploids in which the increase of chromosome number is a result of the grouping of different chromosome sets, as takes place in hybridisation. *R. scutatus*, however, belongs to the *Acetosa* section, in which no polyploid forms or species were recorded, and the present form represents the first instance of polyploidy in this section. How far the doubling of chromosome number affected the behaviour of the plant, either morphologically or cytologically, will be explained later.

Since the discovery of sex chromosomes in *R. acetosa* (Kihara and Ono, 1928), this genus is coming more and more into prominence. Sinoto (1924) was the first to describe the first reduction division in *R. acetosa*. He found the chromosomes to be arranged telosynaptically in a manner very similar to that of *Oenothera*. Kihara (1927) made a critical study of the first meiotic division of *R. acetosella*, and describes the chromosome arrangement as parasynaptic. The present work shows that this tetraploid form of *R. scutatus* agrees to a considerable extent with Kihara's description of chromosome synapsis in *R. acetosella*.

The synapsis of chromosomes has long been a very disputed question in cytology. There are still instances where the observations of the two opponent schools on the same material are very similar to each other, but the interpretation and conclusions are different. In such cases only further study is capable of deciding in favour of one or the other. Otherwise, as clearly stated by Gates (1911, 1928), there is equally good evidence of both forms of synapsis of chromosomes in both the plant and animal worlds.

The part played by the nucleolus in nuclear division has always been a mystery. The results of the present work show that the nucleolus in *R. scutatus* and in several other species of the same genus does not directly contribute material to the formation of chromosomes. A new hypothesis as to the chromatin deposition on the thread and the subsequent formation of chromosomes will be described.

MATERIAL AND METHOD.

At the suggestion of Prof. R. Ruggles Gates, material was collected from several *Rumex* species grown at the Royal Botanic Gardens at Kew, in the summer of 1927, by Miss F. M. L. Sheffield and Dr. J. Latter. As the flowers are too small to be handled separately, short pieces of inflorescence containing about three flowers each were fixed. The fixatives used were Carnoy, Bouin, Allen's modification of Bouin, Flemming's strong and weak, Flemming's (perchloric), and chromo-acetic.

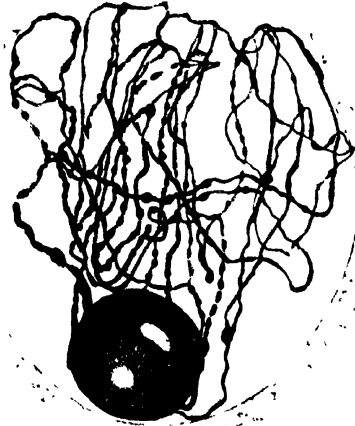
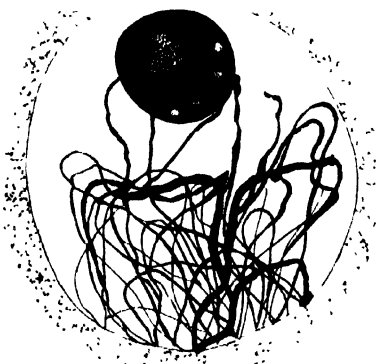
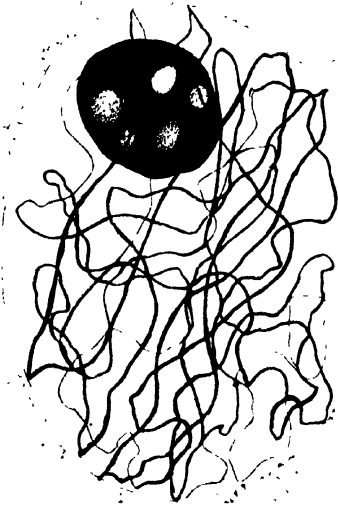
A preliminary examination of the fixed material showed that *R. scutatus* fixed in Carnoy gave the best results. Material of *R. scutatus* was therefore collected again by me in the summer of 1928. The fixatives largely used were Carnoy and a modification of Carnoy by Denham (1924).

Denham's modification gave very good results, especially in later stages



2 a

2 b



6

7

of the first division (from early diakinesis to telophase). The higher percentage of acetic acid in Denham's Carnoy increases the volume of chromosomes by swelling them. The period of fixation varied from half an hour to three and a half hours instead of twenty-four hours.

A comparative study of the effect of fixatives on the nucleolus was made on various other *Rumex* species. Sections were cut varying from 6 to 14 μ in thickness; the nucleus in open spireme is about 10–12 μ in diameter.

The stain was iron-alum Heidenhain-hæmatoxylin, which was almost exclusively used without a counterstain. Brazilin was sometimes substituted for hæmatoxylin. Flemming's triple and gentian violet iodine were also tried, but all drawings are from the first stain combination. Best results were obtained from short mordanting and longer staining—about 2 hours in the mordant and 4–5 hours in the stain.

DESCRIPTION.

The Resting Nucleus of the Pollen Mother-Cell.

The Last Pre-Meiotic Division.—This seems to take place fairly rapidly. In the same loculus one could see all stages from early prophase to late telophase. Fig. 1 is a late pre-meiotic telophase where the new cell-wall has not yet been formed. The two daughter nuclei contain each two or three nucleolus-like bodies, a few other smaller ones, and several small dark-staining granules scattered in the nuclear cavity.

The nucleolus-like bodies are spherical, with a smooth surface, and stain very darkly; they show no signs of vacuolation, and are probably formed by the coalescence of the smaller ones, which latter seem to be formed from the running together of the dark-staining granules. In fig. 2, *a*, the dark-staining granules have almost disappeared and the nucleolus-like bodies have given rise to two large ones and a very small one. These will, later on, fuse together to form one large nucleolus, fig. 2, *b*, which is the prevalent condition in the resting nucleus.

The Resting Nucleus.—The pollen mother-cells do not seem to undergo a resting period of any considerable extent. The sporogenous tissue is always compact, with no intercellular spaces, the cells spreading right out to the tapetum, with which they are in close contact. Each cell is polygonal in cross-section, and is surrounded by a thin wall and filled with finely-granulated cytoplasm in which the nucleus lies in a nearly central position. In well-fixed material the cytoplasm is of a very fine meshwork and contains no dark-staining bodies.

The nucleus is always nearly spherical, the nuclear membrane is very thin and hardly distinguishable. Within the membrane and continuous with it is a very fine reticulum; in many cases the reticulum is so fine that the threads could not be distinguished, and the nuclear cavity appears to be filled with a fine granulated substance. In a central position of the nucleus, or

nearly so, and within a clear zone, lies the nucleolus. This is usually single, but in a few exceptions two equal but smaller ones, or one large and one small nucleolus, could be seen. The extent of the clear zone round the nucleolus also varies from a very small area to a fairly large one: there is, however, a distinct relationship between good fixation and smallness of zone. McClung (1929) is of opinion that in well-fixed material the nucleolus will not be surrounded by a clear space. According to him, this space is simply due to the shrinkage of the other nuclear contents away from the nucleolus, generally because of inadequate fixation of the karyolymph.

The nucleolus lies free in the clear zone and is distinctly not connected with the reticulum. At this stage the nucleolus usually appears as a homogeneous (as far as the staining reaction could show) spherical solid body. In certain preparations, however, it shows slight indications of vacuolation, which become more and more apparent and general with the advent of the first maturation division.

The Prophase.

The first sign of activity appears in the reticulum. Its meshes become coarser and the threads more noticeable. There is also a slight increase in the size of the nucleus. The vacuolate structure of the nucleolus becomes more apparent.

The Leptotene Stage.—The network now gradually resolves itself into a thin thread which spreads throughout the whole nuclear cavity. The thread is distinctly single, without any traces of doubleness throughout its whole length (fig. 3). More than two free ends could be seen in the nucleus even at such an early stage, and although counting of free ends is impossible at this stage, yet their total number is decidedly far below the diploid chromosome number. The thread could also, in certain cases, be followed for quite a considerable length, which indicates that the thread as a whole is not much segmented at this stage. The leptotene thread—its nature, whether single or double, whether continuous or segmented—has always been a cause of great controversy among cytologists. The parasynaptists are of opinion that the leptotene thread is decidedly univalent and that it is usually not continuous, and in certain cases may be segmented into pieces equal to the double number of chromosomes. The telosynaptists, on the other hand, may be roughly grouped under three schools of opinion.

There is first Farmer and Moore's (1905) view. They believe that the thread emerges from the resting nucleus as a single thread showing no indications of doubleness; that later or after the first contraction it splits, and the split halves again approximate and fuse. The second view is that of Digby (1919), who maintains that the early thread, as it emerges from the reticulum, represents halves of univalent threads which tend to run in parallel pairs. Fraser's (1914) view is a slightly modified form of this. According to her, the leptotene thread has a split which is due to a longitudinal fission which took place in the telophase and persisted during the resting stage,

to be completed later on the spindle of the following division. This split, however, in the leptotene thread never divides the thread into two independent separate halves. The third view is that of Gates, who maintains that the leptotene thread is single and univalent throughout its whole length, and that the homotypic split appears only in anaphase or telophase. Occasionally, however, a split may be noticed in some threads in the brochonema stage, or second contraction (Latter, 1927). Thus it may be seen that on this point—the leptotene thread single and univalent—there is agreement between this school and the parasynaptists.

As to the continuity of the thread, however, Gates's school insists on its being continuous till brochonema in telosynaptic forms, when it becomes segmented transversely into loops equal to the haploid chromosome number. Others, however, do not lay any stress on the continuity of the spireme, which, according to them, may be in more than one piece, agreeing on this point with those who hold the parasynaptic view.

The nucleolus keeps its spherical shape. Its vacuoles become more noticeable. It has no definite position inside the nucleus, occasionally lying against the nuclear membrane. Its position relative to the spireme is also variable, but usually it lies within it with threads running over it, some being actually in contact with it. Its staining capacity remains unchanged, with the exception of the vacuoles, which stain paler than the material of the nucleolus itself. In certain preparations the nucleolus looks in middle focus encircled with a layer of very deep staining substance, the vacuoles being also surrounded with such a layer. The nucleolus at this stage also shows the beginning of an increase in size.

The vacuolate appearance of the nucleolus has been recorded several times before in both animal and plant tissues. There are reasons, however, to believe that vacuolation is due to treatment. McClung (1929) has lately expressed the same view in his general treatment of cytological methods. According to him, in a well-fixed nucleus the nucleolus will not show a bubbly structure, but will usually exhibit a smooth texture with sometimes one or more darker structures. The writer is inclined to believe that in the present material vacuolation of the nucleolus is due to treatment. This belief is based on the following observations. First, that in *R. scutatus* the vacuolation varies considerably even in the same fixative. Secondly, that the examination of nucleoli in different species of *Rumex* with different fixatives shows that the appearance of the nucleolus varies in different fixatives. In many cases it is a solid smooth sphere without vacuoles, while in others it is vacuolate, and in others still it has a layer of dark-staining substance enveloping it.

In addition to the abnormal and excessive vacuolation of the nucleolus in certain preparations, there are occasions in which some vacuoles contain one or more dark-staining bodies. These bodies have been described by several observers, some of whom call them crystalline. To the writer, however, they seem to take different shapes. Sometimes they look like an oil globule,

and in others they seem refractive and angular, while in other cases they have a bright centre with a dark periphery which varies from a smooth circle to an irregular and angular polygon. In certain bad preparations these bodies appear not only in some vacuoles but also scattered on the thread, in the nucleus and sometimes in the cytoplasm itself. Again, there are cases in which these dark bodies appear to be not inside the vacuole but lying on the top of it. Yeates (1925) shows that the appearance of these bodies depends on the fixative used. After certain fixatives (corrosive sublimate, formalin and acid fixatives, except methyl green), the nucleoli appear homogeneous with occasional small vacuoles. Following acid methyl green they appear to contain a varying number of small refractive globules. In some nucleoli these fuse to produce one or more large refractive bodies. Yamaha and Sinoto (1925) think that the vacuoles are most likely due to fixation, while more recently Zirkle (1928) found that, while different fixatives affect the staining capacity of the nucleolus, different stains produce different images of it and of the chromatin substance. In 2 p.c. acetic acid the nucleolus appears as a large vacuolate body, while a mixture of 2 p.c. acetic and 4 p.c. formalin fixes it as a solid densely-staining body. It certainly follows from Yamaha and Sinoto's and Zirkle's observations that the dark bodies related to the nucleolar vacuoles are due to treatment.

Some observers, however, seem to be more definite as to the nature of these bodies. Sheffield (1927) describes crystalline bodies as a constant feature of the nucleolus of the pre-meiotic resting nucleus of *Oenothera rubricalyx*. Latter (1926), following the appearance of these crystalline bodies throughout the prophase of the pollen mother-cells of *Lathyrus*, thinks that they give rise to the nucleolar body. The latter body, according to Latter, is an important organ which elaborates chromatin and passes it along to the spireme through a connecting loop. This question will be discussed more fully later. The nucleolus shows no signs of budding or of any amoeboid movement; its shape remains always as near spherical as possible.

The First Contraction.—The thin single univalent leptotene thread now begins to move towards one side of the nucleus. The threads then gradually arrange themselves more or less parallel to each other for a fairly long distance. The parallel threads show a certain degree of polarity, the majority of them running in the same direction across the part of the nucleus where they have contracted. The different successive stages from an open leptotene thread to a contracted polarised one could be seen in the cells of one locus, but a complete polarisation, so characteristic of certain animals, has never been noticed. Fig. 6 shows the most polarised nucleus in my material. In this figure the position of the nucleolus gives the impression that it acts as a centrosome or that it has some relation to the direction of the threads. That this is not true is shown in other polarised cells where the nucleolus seems to take any position relative to the contracted thread. The "leptoten-bouquet" has been described by Kihara (1927) in *R. acetosella*. The writer, however, wishes to emphasise the fact that the form of

polarisation he observed in this material is a *weak* form. The contracted thread never takes the form of a "knot" in the sense described by various writers. The writer is inclined to believe that such a knot does not actually exist in nature, and that its presence in fixed material is due to treatment. Gates is of opinion that it represents a stage where the nucleus is extremely sensitive to reagents, and although the knot as seen in some fixed preparations does not actually exist as such in nature, yet its presence indicates a certain stage through which the nucleus passes at this period. Chodat (1925) expresses the view that the knot is due to the "réactif agissant sur un degré donné de l'état osmotique de l'espace nucléaire." McClung (1929) thinks that the knot "represents simply the collapse of the spireme by reason of lack of support of the coagulated karyolymph at a time when the spireme is particularly slender and delicate." The knot, on the other hand, has been observed and described by several competent observers in very well-fixed material. The fact, however, that it is present in certain cases and definitely absent in others shows that it could not be of any general significance in meiosis.

Although the knot has been the subject of so much controversy, the "contraction figure" is recognised in both plant and animal cytology as a real and definite stage through which the spireme passes in meiosis. The knot is most probably an accentuation of this contraction due to the reagents used.

Zygonema.—The parallel threads now move closer to each other and gradually unite along their length to form double threads. The fusion of the threads proceeds gradually and slowly. In the present material there seem to be two stages of zygonema. The first is when the thread is still thin although double, the doubleness showing here and there as a split or as a wide bifurcation. Fig. 4 is an illustration of this early stage of zygonema. At *a* are regions where the two univalent threads are still apart, although on both sides of this region they have completely united; *b* is a thread which is not united with the same thread throughout its entire length, the end part of it lying adjacent to a different thread. Fig. 5 shows two univalent threads widely separated from each other for a considerable distance and then merged into a thicker double thread.

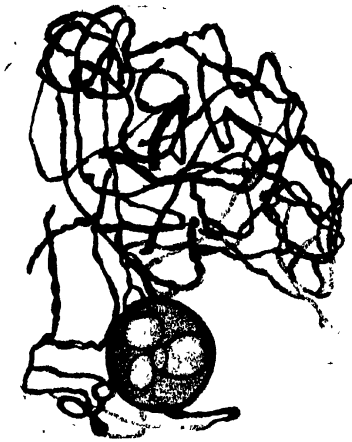
This early stage gradually merges into the second, which differs from the first only in the thickness of the thread. This is a fairly long stage, where the thickening and shortening of the thread take place gradually and slowly all along its length. The thread is single in some portions, while in others it is double, the doubleness being either very much observed or not showing at all. One often comes across relatively thin univalent threads which, when traced backwards along their length, are found to have fused into one thick thread. The univalent threads themselves have also undergone thickening and shortening. Thus it can be seen that this stage is slightly different from the usual zygonema in that it has much thickened and shortened pachytene threads, and different from pachynema in the persistence

of univalent threads which have not paired, some of them lying some distance apart from each other. Figs. 9, 15 and 16 contain drawings of threads from different nuclei in the above stage; they show thick well-formed threads which have not completely paired and others in which pairing is more or less complete. Fig. 9, *a*, shows two independent univalent threads just beginning to pair at one end, and fig. 9, *b*, a piece of thick double thread in the same nucleus. Figs. 9, *a*, and 9, *b*, have been chosen from different nuclei as very clear cases of pairing. They leave no doubt that in the same nucleus there are double and single threads, and that doubleness is due to the pairing of univalent threads, not the approximation of two halves of a thread or the closing-up of the homotypic split.

The above description and arrangement of events agree to a large extent with those of Kihara in *R. acetosella*. But in the present material the "zygonema-pachynema" stage (applying this term to the particular stage described above) extends over a long period. According to Kihara, the thickening and shortening of the thread take place in a stage where the doubleness of the thread could no more be noticed, i.e., during pachynema, whereas in the present material the thickening and shortening of the thread take place while the threads are slowly pairing, and extend over a fairly long period.

The Second Contraction.—After pachynema, Kihara describes in *R. acetosella* a second contraction which he calls "later synapsis," and which is represented in his drawings by a polarised pachytene thread. The present material shows three differences from Kihara's observations. Firstly, that the second contraction is not always polarised; secondly, that polarisation, when it happens, is of the *weak* form referred to above in leptonema; and thirdly, and most important of all, that it does not occur in pachynema, but in the so-called zygonema-pachynema stage.

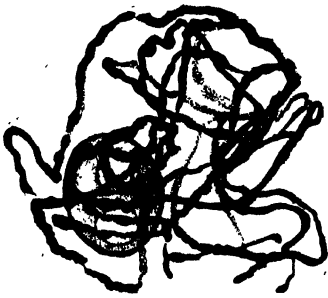
Fig. 7 is a drawing of the most polarised nucleus I came across in my preparations. It can be seen that it differs from a usual form of polarised pachynema in the presence of thin and thick threads, and that the majority of the thin threads are those which are lying parallel and close to each other. It is very likely that second contraction in this material represents a stage where synapsis is completed; this interpretation seems to be also in harmony with the fact that during the first contraction there is a weak form of polarisation, variable in degree. It may be contended that what is called second contraction in the present case is but a first contraction in which some threads have already paired and appear thick while the others are still pairing. The writer has, however, satisfied himself on this point in the following way. Firstly, the period between the two contractions is long enough to make them quite unlikely to take place, not only in the same locus but even in the same flower. Secondly, the width of the thread; thus while in first contraction the leptotene thread is thin, in second contraction even the univalent threads are comparatively thick and stain darker. Thirdly, and more important still, is the condition of the tapetal cells:



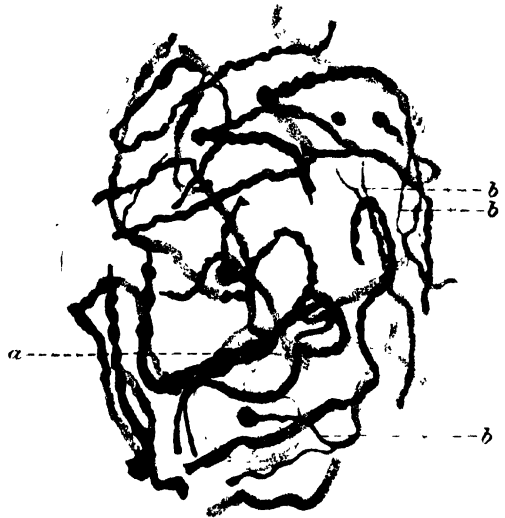
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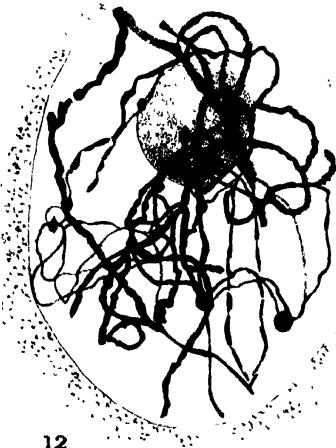
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these are uninucleate in leptonema and definitely binucleate in second contraction.

The Open Spireme.—This stage is represented in fig. 10, which shows a real pachytene thread where pairing is complete, and no signs of doubleness could be noticed at all. It is a comparatively short stage, in which the threads spread out in the nuclear cavity and are nearly of the same thickness. Apart from the casual bending of some parts of the thread, which is apt to happen in a thread coiled in a limited space, the regular appearance of loops described in telosynaptic forms of plants at this stage are missing (Farmer and Moore, Fraser, Gates, Latter, *et alia*). This loop stage and the subsequent brochonema stage (Gates and Latter, 1927) do not occur in *Rumex*.

The nucleolus now shows a considerable increase in size and retains its staining capacity. The vacuoles are still present, and are void of any inclusions. There is decidedly no definite fixed connection with the spireme, and the shape of the nucleolus is still spherical.

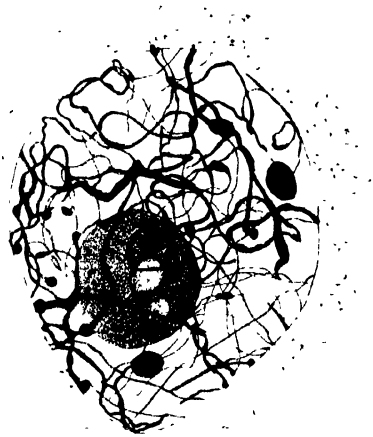
The extent of association of the conjugating threads in pachynema, i.e., whether they simply lie side by side or actually fuse and merge into each other, has been the subject of much discussion owing to its great bearing on certain genetical results and on chiasmatypy. Certain observers maintain that the double nature of the thread persists from synzesis throughout pachynema (Gregoire, 1901, 1910; Wenrich, 1915, 1917; Chipman, 1925). According to Chipman, a spireme which appears single owing to complete fusion of the associating threads occurs seldom or else is due to imperfect fixation. Taylor (1929) is of opinion that the disappearance of doubleness is due to clumping of chromatin and bad fixation of karyolymph. There are other observers, however, who maintain that the fusion of the pairing threads is so complete that the double nature of the thread could not be detected. In *R. acetosella*, for example, this condition of the thread has been described by Kihara. The pachytene thread of the present material does not show signs of doubleness at all, at least over the greater part of the thread. The study of stages slightly earlier than pachynema reveals varying degrees of fusion through which the conjugating threads have possibly passed. In fig. 16, *a*, the two univalent threads appear twisted round each other only along a portion of their length, while fig. 16, *b*, shows a tighter twist in the portion of the threads which have already conjugated. Indications of a twist are also shown in variable degrees in some of the other drawings of pairing threads. That the fusion of the conjugants may be due to a close twisting together with the two leptotene threads is highly probable. There are, on the other hand, threads which have paired and fused along part of their length without indications of a twist in the fused portion, fig. 16, *c* and *d*. In the present material, therefore, fusion between the conjugating threads actually takes place, and this fusion is in certain cases due to a tight twist between the conjugants.

The Segmentation of the Spireme.—So far the spireme has not segmented,

although the number of free ends seems to have slightly increased. Nevertheless, certain portions of the thread could be followed round for a considerable length. Fig. 11 shows a later stage in which the thread has segmented into more or less short pieces. In this figure, 14 separate portions of the thread could be counted. The rest of the thread is so entangled together that it is difficult to see whether it is also segmented or partly or completely continuous. One thing, however, is certain—that what remains of the thread after the 14 pieces which could be counted separately could not form 26 chromosomes (diploid number being 40), and that, on the other hand, there is every suggestion that the remaining entangled thread contains about 6 chromosomes. This observation rules out any suggestion that in this case the threads are univalent, and also gives strong evidence in favour of their bivalency. The free ends are sometimes thin compared with the middle parts of the threads themselves, giving the latter a tapering appearance. The significance of this in this material is not quite known. Later on, in diakinesis and in metaphase, the majority of the homologues are connected at one end to each other, and it would be interesting to find out whether the diakinesis and metaphase connections are represented at pachynema by these attenuated ends. In *Oenothera lamarckiana* the chromosomes in pachynema lie at some distance from each other, being attached together in a continuous chain by extraordinarily long, fine faintly-staining threads (Sheffield, 1927). These thread-connections continue in diakinesis and in metaphase, after which they disappear in the cytoplasm (Gates, 1928). In *Lathyrus odoratus*, Latta (1926) finds the same arrangements of chromosomes in pachynema. According to Latta, the connecting strands are presumably part of the true chromosomal substance, and “consist of attenuated ends of adjacent chromosomes, as at segmentation they are not cut off and left free in the nuclear cavity, but are drawn into the total composition of one of the formerly connected bivalents.” Latta, however, in the above argument seems to have overlooked the possibility that the “attenuated strands” could disappear by undergoing transformation or dissolution into the karyolymph instead of by being “withdrawn into the total composition” of the chromosomes. The writer is of opinion that not until the interrelation of the so-called linin, chromatin, and karyolymph is clearly elucidated could the nature of these thin thread connections be definitely known.

Splitting of the Spireme: Diplonema.—Segmentation and splitting take place more or less concurrently, but while the first most probably begins earlier, the second is extended over a longer period. In fig. 11 thread *a* hardly shows the split which is just making its appearance, while threads marked *b* show doubleness quite clearly; the constituent univalent threads have in some cases considerably separated from each other.

That the present split is a longitudinal division of a bivalent thread into its constituent univalent threads, and not a homotypic split or an approximation of the two halves of a univalent thread, is supported by the following



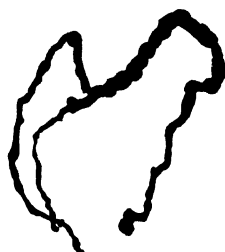
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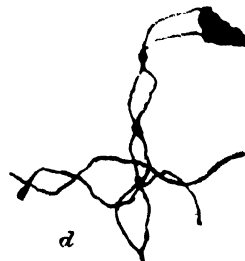
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observations: (1) the number of the threads referred to above in fig. 11, where the segmented threads could not be univalent; (2) the split halves of each bivalent thread do not approximate more and more as the nucleus develops, but, on the contrary, separate from each other further and further; fig. 17 shows threads where the splitting has advanced to such an extent that it is impossible to look upon it as merely a preparation for the homotypic split; (3) the absence of a more advanced stage where the split has completely closed up and the thread appears thick and single; (4) the study of the subsequent stages. The split halves of the bivalent threads now get more and more separated from each other and spread throughout the nucleus.

The radial arrangement of certain threads described by Kihara at this stage in *R. acetosella* has not been observed here. This may possibly be due to the fact that in *R. acetosella* there are rings of six chromosomes, while in the present material there are pairs only.

The Diffuse Stage.—The univalent threads now, instead of shortening and thickening to form chromosomes (Kihara, 1927), or of going into second contraction, become thin and pale-staining and spread out, filling the whole cavity of the nucleus. They then become diffuse and impossible to follow to any appreciable distance (figs. 13 and 14); they seem to loosen up and lose much of their definition. Dark-staining bodies make their appearance, scattered here and there in the nuclear cavity, and all appear to be related to the thread. The appearance of these "chromatic bodies" at a time when the threads become slender suggests that they owe their origin to some of the substance of the thread itself. This stage has been described several times in animals, in Urodela, Homoptera, and various Orthoptera (Wilson, 1925), but it has probably not been recorded before in plants.

The nucleolus still retains its spherical shape, while its size has not been noticeably reduced. There is no apparent change in its staining capacity; the vacuoles still stain paler than the ground substance. If staining capacity or colour reaction could be used as indications of loss or otherwise of chromatin from the nucleolus up to this stage, then it is evident that the loss is either very small or nil.

Early Diakinesis.—The thin threads of the diffuse stage then gradually shorten and thicken, while the "chromatic bodies" gradually disappear. Fig. 13 illustrates this stage, where shortening and condensation of the threads are still proceeding. This process extends over a fairly long period till it culminates in the formation of thick irregular pieces of thread of different sizes and shapes. As condensation proceeds still further (figs. 32 and 33), the chromosomes of early diakinesis could now be distinguished lying usually in pairs in the nuclear cavity. Figs. 18, 19 and 20 are nuclei in a slightly later stage of diakinesis where the chromosomes have undergone further condensation. At this stage the chromosomes are usually in pairs, which exhibit different forms (fig. 34). The homologues constituting a pair may form a loop connected at one or both ends with sides either parallel

to each other or twisted over one another, or they may just cross over each other while their ends are not connected, or one of them may have the form of an arc with the other lying in the arc and at right angles to it. There are also cases where one end of a homologue, instead of being connected with the end of the other homologue by the usual thread connection, is actually fused to that end, and the homologues themselves either lie side by side more or less parallel to each other or cross over each other.

Rings of more than two chromosomes are sometimes noticed at this stage, four usually constituting a ring (figs. 35, 37 and 38); the connections of such rings, however, seem to break before diakinesis. In some of these rings the relative sizes of the constituent chromosomes throw light on their mode of synapsis. In figs. 35 and 37 there are rings of four which have each two long and two short chromosomes, the homologues of each kind lying parasynaptically side by side. Fig. 35, *a*, shows a clear parasynaptic arrangement in which the members of the two homologous pairs have twisted round each other once.

Diakinesis.—The chromosomes continue to shorten and condense and gradually spread out into the nuclear cavity. They show a wide range of sizes from small round chromosomes to elongated ones. There are usually two pairs of big chromosomes of approximately the same size. Either both or sometimes one of them occupies a peripheral position. They are represented in figs. 35 and 36, which are drawn from different nuclei. It will be noticed that one of the big pairs is connected to another small pair. This arrangement is very often seen, especially in early diakinesis before the connections break away. Intermediate stages where the small pair is still partly connected to the big one, or where it is just lying close to it, could also be seen, even in diakinesis (fig. 18). In this figure *a*, the small pair, seems to have moved round a little, shifting with it one of the connecting threads, which now appears stuck to the side of one of the big chromosomes.

The chromosomes now are more strictly in pairs; very rarely does one meet with four connected to each other. On very few occasions I came across rings of three chromosomes, each nucleus containing two of such rings (fig. 20, *a* and *b*). This association of three chromosomes was also noticed in anaphase, where in polar view a group of three chromosomes lying close to each other could be seen in each of the daughter plates (fig. 26).

Metaphase.

At metaphase the condensation of chromosomes is complete. There are always 20 pairs of chromosomes; the members of each pair are not fused to each other to form gemini. Noda (1926), examining the diploid species, records the same behaviour. Meurman (1925) noticed the same phenomenon in *R. thyrsiflorus* and *R. acetosella*. On the other hand, other observers, working on other species of *Rumex*, describe a more or less complete fusion of homologues to form bivalent chromosomes at late diakinesis and meta-

phase. Thus Sinoto (1924), in *R. acetosa*, notices that in multipolar spindle the bivalents condense into short rods without any indication of double nature. Kihara and Ono (1926) figure a metaphase plate of *R. scutatus* containing 10 gemini showing no double nature at all, while in *R. hydrolapathum* they speak of gemini which are very firmly fused. Jaretsky (1928), in his study of the pollen mother-cell of *R. roseus*, notices that in metaphase the homologues lie, as a rule, so close to one another that they appear like single chromosomes. Shimamura (1929), in his study of *R. pulcher*, counts 10 bivalent chromosomes in metaphase, each bivalent showing no signs of doubleness whatever. It is interesting to note that all the above workers on *Rumex* and also the writer have used the same fixative, namely, Carnoy. How far this difference in behaviour is significant it is difficult to say.

The chromosomes at metaphase show distinct size differences. The writer, however, has not been able to classify them into size groups because the differences are not big enough to make tabulation possible. Nevertheless, two large pairs are always distinguishable. Noda notices that one pair is always larger than the others and lies at the periphery of the nucleus. Jaretsky examined the root-tips of the diploid form, and records a great diversity of size and shape of the chromosomes. According to him, there are at least two large ones and six small ones in addition to other intermediate sizes.

The nucleolus has by now completely disappeared. Its disappearance, however, is not so abrupt and mysterious as has been recorded by other observers. Since diakinesis there has been a gradual decrease in its size until it ultimately disappears about the time of the formation of the multipolar spindle. The large nucleoli are found in the cells in diakinesis at the bottom, while the smallest ones belong to the multipolar spindle and metaphase nuclei in the middle of the loculus. Just before disappearing, the small nucleolus becomes like a meshwork with very little of its ground substance left in patches, which, however, still stain very dark as the ground substance of the prophase-nucleolus. The holes in the meshwork appear most colourless in contradistinction to the pale appearance of the vacuoles of the large prophase-nucleolus. The small nucleolus might also, though rarely, break up into two smaller ones which disappear later. The nucleolus always keeps its spherical shape and takes any position inside the nucleus. There is no budding and no chromatin granules which pass out into the cytoplasm at the time when the nucleolus disappears. There is every suggestion that, from diakinesis to metaphase (or perhaps just before metaphase), the nucleolus gradually dissolves out into the karyolymph.

The nuclear membrane has now completely disappeared. At diakinesis it becomes so thin that it could only be distinguished from the cytoplasm with difficulty, so much so that in certain cells one could not be positive of its existence. The nuclear membrane usually disappears just before the formation of the multipolar spindle. There is no strong evidence, however, that the fibres of the spindle are formed by the nuclear membrane itself.

There are few instances where the nuclear membrane has completely disappeared without any spindle fibres making their appearance. At multipolar spindle the chromosomes are still more or less spread out in the nucleus, lying in alignment with the fibres which cross the nucleus extending from one pole to another (fig. 22). As the multipolar spindle becomes bipolar, the chromosomes move towards the equatorial plane of the nucleus, where they lie in pairs separated from each other. Directly after the disappearance of the nuclear membrane the nuclear cavity becomes filled up with cytoplasmic material which is less dense than the surrounding cytoplasm. The nuclear area, however, remains recognisable for some time during anaphase.

Anaphase and Telophase.

A side view of an early anaphase shows that the homologous chromosomes are equally distributed on both sides of the equatorial plane, each chromosome on one side having a recognisable homologue on the other side (fig. 29). The distribution of the chromosomes to the poles is therefore usually normal, and the chromosome sets which form the daughter nuclei ought to be in such cases identical. Observation shows that such is actually the case, as in polar view of middle and of late anaphase each chromosome in one anaphasic plate has in the other plate a homologue which is not only similar to it in size and shape, but also corresponds to it in position (figs. 24-26). The chromosomes belonging to one haploid set in anaphase, however, do not all move to the pole with the same velocity. Thus in early anaphase—in a side view, for example—one could see homologous chromosomes which are still attached to each other end to end. The latter may either be connected to each other with the thin thread connection of diakinesis or with a fairly thick band of chromatin which stains as deeply as the chromosomes themselves. Noda (1926) described these "chromatin bridges" in the diploid form of the present species, while Sinoto (1924) also refers to them in *R. acetosella*. Meurman (1925) confirmed Sinoto's observations and also observed the "bridges" in *R. thyrsiflorus*. Fig. 28 is an oblique view of a later anaphase which shows a fairly long chromatin bridge extending between two chromosomes.

The size differences between the chromosomes of one set are still apparent; the extra big pair of chromosomes, however, could not now be so easily distinguished as in earlier stages. Noda refers to a pair of big chromosomes which always lags behind in anaphase. In the present material no such behaviour could be assigned to any particular chromosomes. Occasionally, in the polar view of an anaphase, one meets a group of three chromosomes lying close to each other as if there is a certain attraction between them; their three homologues are also found in the same condition in the other plate (figs. 24-26). Such a tri-arrangement of chromosomes has been noticed in certain nuclei in diakinesis (fig. 20), but it is only of rare occurrence. Huskins (1927), in his study of fatuoid oats, observed such arrangement as



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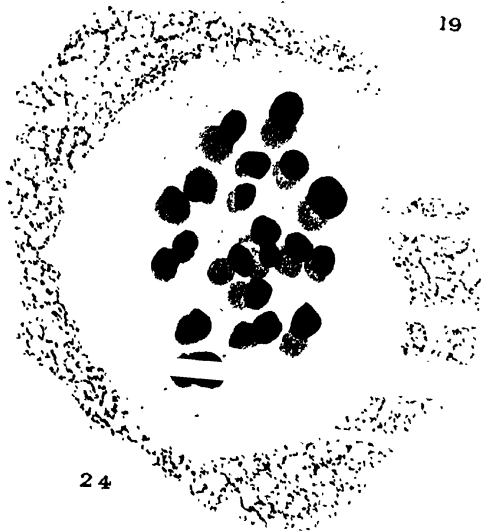
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frequently happening in the heterozygous fatuoids in diakinesis and metaphase. Instead of having the usual 21 pairs at diakinesis, the pollen mother-cells had 19 pairs, one trivalent and one single chromosome.

Another extraordinary phenomenon in the anaphase arrangement of chromosomes has also attracted the attention of the writer. By comparing figs. 24 and 25, which are both polar views of anaphase taken from different plants which were fixed in different fixatives, a certain kind of resemblance between the arrangement of chromosomes in the two nuclei could be noticed. Thus, beginning with the top left side, there is in each cell a row of three pairs more or less similarly orientated, in the middle left there is another row of three pairs running horizontally, while in the bottom left there are two pairs and in the bottom right three pairs, and so on. From such a resemblance in arrangement between the two cells one is tempted to think that the chromosomes are not scattered haphazardly in the cell, but are arranged in a certain order. The present kind of arrangement, however, although quite different from that described by Cannon (1923) in his hypothesis on the nature of centrosomal force, yet seems to add some weight to the postulate that the arrangement of chromosomes in metaphase and onwards is governed by a certain mechanism. Cannon's hypothesis deals with chromosomes of approximately equal size acted upon by two forces, one of repulsion from the centrosomes, another of attraction between the chromosomes themselves. In the case described here the chromosomes are of different sizes on the one hand, and on the other hand there are no centrosomes. Cannon's hypothesis, moreover, is concerned with the distribution of the chromosomes in rings, each ring possessing a certain fixed number; it does not deal with the relative positions of the chromosomes constituting each ring. Cannon, again, bases his hypothesis on the physical and physico-chemical nature of the chromosomes and centrosomes. The arrangement of chromosomes referred to in the present material is more probably due to a certain sort of balanced attraction between all the chromosomes constituting a set. The writer, however, is not inclined to lay much stress on this point now, as he has not got enough observations to justify any definite conclusions.

Non-disjunction.—This phenomenon was first recorded in plants by Gates (1908) in the heterotypic division of the pollen mother-cells of *Oenothera rubrinervis*. Since then it has been recorded in many cases. It seems to be of more frequent occurrence in polyploid forms and in hybrids. Thus Belling and Blakeslee (1923) have found that although non-disjunction, under ordinary conditions, is rare in the diploid form of *Datura*, it is of regular occurrence in the tetraploid plant, in which it happens in more than 25 p.c. of the pollen mother-cells. Gates and Sheffield (1929) describe both single and double non-disjunction as occurring in two hybrids of *Oenothera*; they also state that an appreciable percentage of six-eight divisions, i.e., single non-disjunction, has been observed in most *Oenothera* species which have been examined cytologically. In *Rumex* single non-

disjunction has been recorded by Kihara in the pollen mother-cells of *R. acetosella*.

The present study adds another tetraploid form where single non-disjunction has been observed. Fig. 26 is a polar view of an anaphase of one nucleus. The two chromosome sets are drawn separately to avoid confusion due to chromosome overlapping. The group marked *a* contains 21 chromosomes, while *b* contains only 19. Fig. 27 is a side view of an anaphase in which one pair of non-disjoined chromosomes can be seen going to the upper pole of the spindle (in this figure all the chromosomes are not drawn, as some could not be easily distinguished).

The homotypic split has so far not made its appearance; the characteristic V-shaped chromosomes often described by observers at metaphase and afterwards have not been seen in the present material. This peculiar delay in the homotypic split has also been observed in other *Rumex* species. Kihara (1927) states that in *R. acetosella* the univalent chromosome does not very often split in anaphase. Shimamura (1929) does not record the split in *R. pulcher* till telophase. There are other cases, however, in plants and also in the majority of animals where the homotypic split appears much earlier. According to Wilson (1925), it makes its appearance early in the meiotic process, sometimes soon after synapsis, in some cases possibly even earlier.

In the present material the split appears at telophase after the chromosomes have reached the poles of the spindle. At telophase, and just before splitting, the chromosomes still show size differences; in form they are mostly nearly spherical, some are slightly angular, but none of them is elongated.

DISCUSSION.

The Nucleolus.

Is the nucleolus an organ of a certain function in the life-history of the cell, or is it a by-product of the metabolism of the nucleus? This is the question which cytologists set themselves to answer since fifty years ago, and on which, so far, there is no general agreement.

I. There is the view that the nucleolus contributes material indirectly to the developing spireme. Among the earlier cytologists, Macfarlane contended that the nucleolus contained the mass of chromatic substance. Strasburger (1882) and Guignard (1885), on the other hand, maintained that it consisted of a substance which is allied to chromatin, and which, during prophase, becomes dissolved in the nucleus, to be used up in the building of the chromosomes. More recently Gates (1907) has expressed the view that the nucleolus is composed of two substances—a yellow staining ground substance which dissolves away and disappears in the cytoplasm in late prophase, and a cover of deeply-staining substance which gradually dissolves out in the nuclear sap during the formation of chromosomes. The same

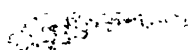


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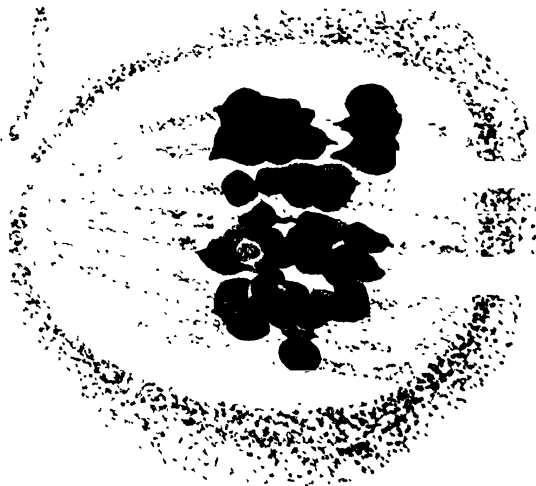
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author (1908) describes the presence of several "chromatic bodies" or "small nucleoli" which get entangled in the thread to which they ultimately pass their material. Digby (1909, 1910) describes, in *Galtonia candicans*, bodies which appear as nucleolar buds during prophase. In certain fungi, the Laboulbeniaceæ, Faull (1912) finds that the nucleolus becomes vacuolate and at times even somewhat honeycombed. During synaptic contraction, when the threads are matted to one side of the nucleus, their connection with the nucleolus is probably maintained. During mitosis the nucleolus steadily diminishes in size, and a portion of it still remains up to the time when the daughter nuclei begin to form. In Pteridophyta, in the meiotic division of *Equisetum arvense*, Beer (1918) describes the nucleolus as actively extruding material from its surface in the form of droplets or buds. "At the same time there is growth in thickness of the spireme segments and a great increase in their staining power. The droplets pass into the nuclear cavity and become distributed along the spireme thread, to which they adhere." Schurhoff (1917) states that there is a constant and progressive diminution of the chromaticity of the nucleolus during nuclear division, and that this is a sure sign of its acting as a storehouse for the stainable substance of the chromosomes. The same or similar views are also held by other various investigators—Van Camp (1924), Cleland (1922, 1924), McPhee (1924), and others.

II. There is also the view that the nucleolus contributes material to the developing spireme through a direct channel which is actually connected to the nucleolus itself.

As early as 1895 Farmer described such a connection in the Liverworts as being present in an "unmistakable and remarkable manner." Walker (1913), in *Polytrichum*, speaks of a large nucleolus-like body in which almost the whole of the chromatin is stored, and which is connected to the peripheral reticulum by delicate radiating threads. During prophase the chromatin is passed along these radiating threads, which consequently thicken and give rise to the spireme.

Latter (1926) describes a constant association of the spireme with an endonucleolar body during the early prophase stages. The function of this body is the elaboration of chromatin and its transformation to the thread. The connection between the nucleolus and the developing spireme was also described in *Oenothera* (Sheffield, 1925) and in two species of *Lathræa* (Gates and Latter, 1927).

There is another group of observers who find a direct thread connecting between the nucleolus and the spireme, but believe that the material passed from the nucleolus to the thread is not chromatin, and that that non-chromatic material persists as such in the thread itself; or, in other words, that the developing spireme is composed of two different substances—the nucleolar substance and chromatin. Lenoir (1922), in *Equisetum arvense*, speaks of the "nucleoline" passing out from the nucleolus to the spireme to constitute its axis, and that this process continues till the nucleolin is

completely absorbed. At telophase the chromosomes pour out the substance of their core as fine drops of nucleolin, which condense and fuse together into a single nucleolus. The latter then forms round itself a thick pellicle of chromatin. In another paper, on *Fritillaria imperialis* (1922, b), Lenoir says that at the formation of the spireme some filaments place themselves in contact with the three or four nucleoli present at that time. At these points Lenoir maintains that there is a real continuity between the chromatic threads and the nucleoli, the substance of the latter passing through the threads. The chromosomes are thus formed of a sheath of chromatin enveloping a voluminous axis of nucleolin. Lenoir concludes by saying that the substance of the nucleoli "passe sans modification apparente dans le filament spirematique par une sorte d'aspiration." At early telophase—eutelophase—the nucleolin begins "à se substituer plus ou moins complètement à la reticuline" or chromatin. At late telophase—metatelophase—the two substances separate; the nucleolin forms the nucleoli, while the reticuline, whose quantity has now increased, forms the net of the resting nucleus. In the embryo-sac Lenoir describes the vacuolate appearance of the nucleolus in prophase as due to a "rupture de l'équilibre dans la composition biochimique" of the embryo-sac. This "rupture" of the equilibrium is due to an invasion of cytoplasmic substance into the nucleus. The nucleolus in its vacuolate form simulates a drop of a viscous liquid which is boiling, and whose particles, as they reach the surface, give rise, not to a gas, but to a colourless liquid. More recently Lenoir (1925) speaks of reticulo-nucleolin nucleoli which are formed in telophase in *Fritillaria*, and of reticulo-nucleolin granules which exude from the chromosomal filaments at telophase, and which are thrown out into the cytoplasm, where they appear as plasmatic nucleoli. Zirkle (1928) studied the nucleolus in mitosis in the root-tips of *Zea mays*. According to him, the spireme is like a collapsed rubber tube through which the nucleolar material flows. As a result of his micro-chemical tests, he states that the nucleolus contains no chromatin, but another substance which he calls "plastin." The latter constitutes the core of the spireme. At telophase the nucleolar material collects into several droplets which flow together and form the nucleolus of the resting cell. Thus he shares with Lenoir the view that plastin, or "nucleoline" of Lenoir, is continuous from generation to generation, and that a certain amount of it, "perhaps merely an excess," fragments and passes out into the cytoplasm in the form of granules which ultimately disappear. Later on he says "it is tempting to see in this a mechanism for carrying the influence of genes to the organism."

After giving the above short survey of observations on the nucleolus in several examples in the plant kingdom, and the various interpretations made from such observations, I will now proceed to examine them critically as a whole to see how much support they give to the transportation theory of the nucleolar material, and to show that such a theory has been based on observations which could hardly even be considered as evidence of its existence.

1. The vacuolation of the nucleolus during prophase. In criticism there is first the view that vacuolation is an artefact, a view which is strongly sustained by the writer's observations on the effect of different fixatives on the nucleolus of various *Rumex* species and also by the work of Yamaha, Sinoto and Zirkle, referred to above, who used a wide range of fixatives and applied several micro-chemical tests.

Apart from the above, and assuming for the sake of argument that vacuoles in certain cases are natural, their presence could not be of any significance in the question we are now considering. Firstly, because in the majority of cases in which vacuolation has been recorded the nucleolus is vacuolate at resting stage or perhaps soon after the beginning of prophase. Since these vacuoles appear so early, before there is any noticeable thickening of the thread, it seems hardly likely that their presence could mean that the nucleolus has contributed material to the chromosomes. Secondly, because it is very difficult to see how these vacuoles could contribute material to the chromosomes. In fixed preparations they stain paler than the ground substance of the nucleolus itself. What does this picture signify? Does it mean that the vacuoles are now empty after having passed out their chromatin into the nucleus, or that they contain a pale-staining material which they gradually contribute to the chromosomes? Neither supposition could be held for the following reasons. Firstly, the process of nucleolar transportation, if at all true, takes place gradually; thus in addition to empty vacuoles we ought also to come across others which are still partly filled with their material. Secondly, if the vacuolate appearance signifies droplets of a different liquid held in the nucleolus, we ought to see a very vacuolate nucleolus in resting stage and a much less vacuolate or even non-vacuolate one in diakinesis. This decrease of vacuolation ought also to be accompanied by a proportional decrease in the volume of the nucleolus. All the above expectations based on the supposition that vacuoles signify contribution are diametrically opposite to what is actually observed.

2. The staining capacity of the nucleolus, the supposed interchange of stainability between the nucleolus and the thread, is perhaps one of the weakest evidences that could be put forward in favour of the transfer of material from the nucleolus to the thread. This hasty and not strongly founded opinion is due to too much reliance being laid on colour reactions of one stain only. The dark stain which the nucleolus in resting stages takes in material stained in iron-alum hæmatoxylin could not and should not be considered as a reliable evidence of its chromatic nature. It is only extensive micro-chemical tests which could throw light on the nature of the nucleolus. It is astonishing to note that the results of such tests show that the nucleolar material is different from that of the spireme. Zakarias (1882) was perhaps the first to tackle this question micro-chemically. After a long critical study extending over twenty years, he contends that the nucleolus is clearly different in composition from the chromosomes. Other tests carried out

much more recently give exactly the same result (Yamaha and Sinoto and Zirkle).

Another method of investigation was used by Schustow (1918) in the root-tip of *Allium cepa*. Schustow found that, by using ultra-violet rays as his source of light, he could distinguish between chromatin, which is opaque to the rays, and the nucleolar substance, which is transparent, and by this means he has been able to make an exact count of the real chromosomes at metaphase. He also found that, while the nucleolus stains intensely red with eosin, the chromatin organs (spireme, chromosomes) keep their intensely black hæmatoxylin colour.

The supposed gradual change in stainability of the nucleolus during prophase put forward by certain observers does not convey much sense. If the nucleolus is entirely built up of chromatin, then it should always stain dark, even if it gives out material to the chromosomes; the only effect which should be observed is a gradual decrease in its volume. If, on the other hand, the nucleolus is formed of a core of a substance which stains pale and which is different from chromatin, and which is covered with a layer of chromatin, we should see a microscopical image of the nucleolus depicting such a structure instead of a gradual decrease of its stainability, and we should also see that the chromatin layer is gradually used up, becoming thinner and thinner as the nucleus develops and the spireme forms.

3. The nucleolar buds and the amœboid appearance of the nucleoli have been shown to be due to fixation. They are absent in living material, and in fixed material they only appear in certain fixatives (Zirkle, 1928). Nevertheless, their presence, even if assumed to be natural, could not signify more than that the nucleolus is disintegrating. The released matter of the nucleolus might well be simply dissolving into the nuclear sap, either to be used up afterwards in some way or other in the metabolism of the nucleus, or to diffuse outwards through the nuclear membrane into the cytoplasm.

4. A constant thread connection between the nucleolus and the developing spireme has been noticed by several observers (Gates, Lenoir, Latter, Sheffield, Zirkle). The hypotheses put forward, however, to explain this connection on the basis of nucleolar transportation of material are conflicting and exceedingly difficult, sometimes impossible, to understand. Too much significance has also been attached to the early relationship between the nucleolus and the thread, which is simply apt to happen through their relative position in the limited space of the nuclear cavity.

I will now consider the conflicting hypotheses put forward by Lenoir, Zirkle, and Latter, in explanation of the transfer of nuclear substance by means of an actual connection.

I. Lenoir and Zirkle both hold the view that the substance passed on to the thread from the nucleolus is not chromatin. The nucleolar substance passes unchanged into the spireme to form its core (Zirkle), or its "voluminous axis" (Lenoir), the peripheral part of the spireme being formed of chromatin.



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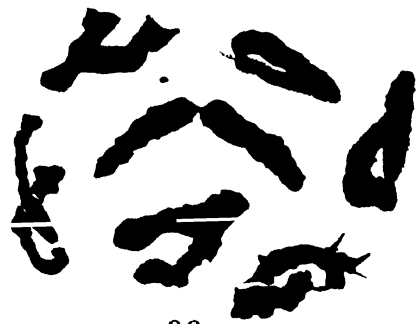
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As regards the way in which the plastin or nucleolin is transferred to the thread, Lenoir speaks of "une sorte d'aspiration," while Zirkle looks upon the thread as "a collapsed rubber tube." As to the means by which the chromatin and nucleolin are formed, Lenoir's conception is that the reticulin increases at the expense of the nucleolin, part of the latter being transformed into the former, while he gives no suggestion as to the means of formation of nucleolin. It is difficult to understand Zirkle's opinion on this point. He first says that "plastin is formed by an increase in the amount of pre-existing material"; then he goes on to say that "in every cell division a certain amount of it (i.e., the nucleolus), perhaps an excess amount, fragments and passes out into the cytoplasm." According to him also, the nucleolus persists till metaphase, when it divides into two, the halves travel to opposite poles and then pass out and disintegrate. Zirkle does not give any suggestions as to the way in which the chromatin increases.

Let us now consider what Lenoir and Zirkle's suggestions entail, and how far they agree with actual observations.

Firstly. The presence of a single connection between the nucleolus and the thread necessarily means a continuous thread at all stages of its formation. In the majority of cases in animals and plants the thread is decidedly not continuous. If the nucleolus-thread connection be, then, of any significance, it would only apply to certain few cases (e.g., *Lathyrus*).

Secondly. The flow of the nucleolin inside the thread. Lenoir's conception of "une sorte d'aspiration" does not give a working hypothesis at all. If he means by aspiration suction due, say, to capillary action, then the final result of aspiration will depend on the nature of the thread. If this has the form of a capillary tube with firm walls—one continuous capillary tube—the nucleolin will have to pass through it gradually and slowly till it fills it all up. If such capillary action actually takes place, we ought to be able to see in our fixed preparations different stages of thread filling, the parts farthest away from the nucleolus being the last to be filled; and there ought not to be any increase in the thickness of the thread once it is filled with the liquid. If Lenoir means that the thread tube is at first collapsed, then the nucleolin could only fill all the capillary spaces between the collapsed walls.

Zirkle, on the other hand, speaks definitely of a collapsed rubber tube, one end of which is attached to the nucleolus, but he leaves us without any clue as to the way in which the plastin could be made, not only to flow through the interspaces of the collapsed tube but to distend it up into the form in which it is usually seen. It is impossible, on physical grounds, to conceive how this could be brought about, and the statement is also incompatible with cytological observations.

Thirdly. Neither Lenoir nor Zirkle have explained how the peripheral chromatin of the thread increases during prophase. According to Lenoir, there is an increase of chromatin at the expense of the nucleolin at the end of the telophase, and if this be the only increase, then the reticulum of the

resting cell should possess all the chromatin in the chromosomes of the subsequent division.

II. Latter's hypothesis is also confronted with certain difficulties. As to the transmission of chromatin, Latter thinks that the threads actually move round in the nuclear cavity, taking up elaborated material from the nucleolar body in passing, the thread during this rotation being always in contact with the body. Sheffield (1927) believes that this is improbable in *Oenothera*, and that it is more likely that the loop is fixed to the body. Although Latter and Sheffield both speak extensively of the chromatin material as flowing along the thread, they give no suggestion as to the nature of the thread or how the chromatin flows in it. Unlike Zirkle and Lenoir, their spireme is finally homogeneous in structure, the substance it takes from the nucleolus is chromatin. What is the original thin linin thread like before thickening takes place? One could perhaps gather, from Latter's description, that it is, at least, not a tube. What is there that could "take up chromatin from the nucleolar body in passing"? Perhaps Latter means that the thread is of a spongy nature or something like a wick full of small capillary tubes through which the chromatin flows. The wick conception, however, is also not workable.

Firstly, it does not explain the enormous increase in thickness of the spireme which takes place during prophase. A dry wick could absorb as much liquid as it could hold without any appreciable increase in its volume, the absorbed liquid simply filling up cavities which are already there. Moreover, it is inconceivable how the wick thread could remain dry while it lies in the karyolymph. Secondly, we ought to be able to see stages in which the chromatin has flowed only in a certain part of the thread, nearest to the nucleolus, while the other part of the thread shows empty. Thirdly, the wick structure ought to be identified microscopically. If the pores or the tubes of the wick are ultra-microscopic, one has to think of the chromatin as an exceedingly thin fluid of a very low density and a very small molecule. In general, unless a more critical explanation of the way in which chromatin flows along the thread, causing its comparatively great thickening, is given by Sheffield and Latter, it seems so far difficult to harmonise the actual observations with their hypotheses.

Latter lays great stress on the position which the nucleolus takes during prophase—flattened against the nuclear membrane—a position which it maintains until early diakinesis. This position, according to Latter, suggests an absorption by that structure of substances from the cytoplasm, "substances which are later on acted upon by the nucleolar body and elaborated into chromatin." The present writer is of opinion that the above significance is overestimated. There could not be any advantage to the nucleolus from its position "flattened against the nucleolar membrane," unless one assumes that in the external cytoplasm there is a particular region which contains the substance that will be worked upon later on, and that the nucleolus flattens itself against that region—an assumption which Latter has not

made, and which does not seem to be at all probable. On the other hand, as long as this cytoplasmic substance—equally distributed in the cytoplasm—has to diffuse osmotically, or perhaps otherwise, through the whole nuclear membrane, there is no advantage whatever gained from any particular position which the nucleolus takes inside the nucleus.

From the above it will be seen that all the evidence put forward in favour of the transmission of nucleolar substance to the chromosomes is conflicting and certain of the facts are disputable.

Apart from the above group of observers who support the nucleolar transmission hypothesis, there is another who attribute to the nucleolus a genetical function of some form or other. Wager (1904) asserts that the whole hereditary theory of chromosomes ought to be revised and put on a new nucleolar and chromosomal basis. Darling (1909) asserts that in *Acer negundo* five chromosomes bud off bodily and full-fledged from the nucleolus; this has, however, been later refuted by Mottier, who examined the same species in 1914. According to De Mol (1926), the nucleolus gives rise to globules which are distributed to the daughter nuclei by the chromosomal mechanism. "The nucleolar globules may, after all, contain some materials stimulating or finishing the genes, whilst the chromosomal structure is especially adapted to transportation of the genes together with these globules to the daughter nuclei." There is also Zirkle's suggestion that the nucleolar substance extruded into the cytoplasm may act as a mechanism for carrying the influence of genes to the organism.

III. Opposed to the above there is also the view that the nucleolus is composed of an ergastic substance, a by-product of the metabolism of the cell. Referring only to the more recent investigators, one could mention Lundegårdh (1912), who studied somatic mitosis in the living cells of *Allium cepa*. According to him, the nucleolus is different from the chromosomes—they have different refringencies—it has no visible relationship with the spireme, and it travels out into the cytoplasm when the nuclear membrane bursts. Sharp (1914) believes that the relations between the nucleolus and chromosomes are indirect and are of physiological order. Then there is the masterly work of Arthur Meyer (1911). He subjected different plant tissues to various modified and unfavourable conditions, and measured the volume of the nucleolus before and after each experiment. He found that the nucleolus either generally diminishes or disappears altogether in tissues whose nutrition has been reduced. In the parenchymatous cells at the base of the leaf in *Galtonia candicans* the volume of the nucleolus was reduced by about 82 p.c. after 36 days in darkness, while two months darkness reduced the volume by 95.5 p.c. In all cases examined by Meyer the vitality of the nucleus was not affected; he therefore considered the nucleolus as an ergastic inclusion, a mass of inert substance resulting from the nutritive activity of the cell. He gave it the same biological value as an oil drop or a starch grain produced in the cytoplasm. Its position inside the nucleus does not signify anything more than its being exclusively related to the nucleus itself,

or, in other words, that the nucleus is necessary for the formation of the nucleolus as much as a plastid is necessary for a starch grain. Yeates (1925) considers the nucleolus as a product of the metabolism of the chromosomes.

The results of the present work on the nucleolus in certain species of *Rumex* furnish no evidence of any transmission of chromatin from the nucleolus to the developing spireme, either directly or indirectly. There are positively no chromatin buds nor chromatic bodies extruded from the nucleolus; no amoeboid form, no flattening against the nuclear membrane, and, most important of all, no recognisable decrease either in the staining capacity or in the volume of the nucleolus till diakinesis. The connections between the nucleolus and the spireme, in the form of threads lying over the nucleolus or touching it, are nothing more than the relative positions of the nucleolus and the spireme and the law of chance could demand. There is no constant and fixed connection between the nucleolus and the spireme. Vacuolation is most probably—if not definitely—due to fixation. During prophase there is a marked increase in the volume of the nucleolus. At early diakinesis—that is, after the complete formation, but not condensation, of chromosomes—it begins to decrease in volume until just about multipolar spindle, when it becomes very small and disappears. From this short summary of the life-history of the nucleolus in the species of *Rumex* studied by me, it seems to me that the nucleolus in these species does not play any rôle in the formation of chromosomes during prophase, and that it is in that sense only composed of an ergastic substance.

In the following few lines I will endeavour to explain my own conception of the formation and development of the spireme, a conception which is based solely on cytological study, and which so far seems to me to explain several genetical and cytological observations. A critical study of the nature of the developing thread during prophase reveals general and well-recognised facts. The thread in early stages is thin and stains pale. Gradually it increases in thickness all over its length, its surface is rugged, rough and irregular, it has constrictions, chromatin globules or chromomeres connected with thin filaments, in the majority of cases it is segmented into several threads, its parts show a sort of independence in development and in behaviour. These general and universally recognised observations all indicate that the agent for the gradual formation and development of the thread lies in the thread itself, or close to the thread in the medium in which it lies. They also indicate that the thread gets the material necessary for its increase in volume from the medium in which it is embedded. In other words, anything that is to be used up or worked upon in the formation of the thread has to pass first into the nuclear sap before it could be utilised by the thread. There is every suggestion that the thickening of the thread is due to a deposition of material upon it, a progressive building-up process, and that the amount and shape and the rapidity of this formation of these deposits is not the same all along the thread—that they may take place in certain portions of the thread and not in others. Are not all these particularities

indications that the thread itself is the seat for the agents of such chromatin deposition? Had it not already been suggested by several cytologists and geneticists that the linin thread itself is the bearer of the character determiners, of the genes which are arranged along its length? It is tempting to think of the genes as possessing certain enzymatic activities—either by being enzymes themselves, or by giving rise to enzymes—by which chromatin is manufactured and laid down upon them. We can then go a step further and think of these gene enzymes as being specific in nature in that each gene would have its own kind of enzyme or enzyme complex, and the chromatin formed by these enzymes would also be specific. A chromosome will thus be conceived, not as a thin thread carrying genes covered and concealed by an inert substance, but as a composite of units, each unit formed by a gene and being the product of the gene and of the elements of which the gene is composed, whether these be enzymes or enzymatic products. Later on, in telophase, these chromatic units are exuded as droplets in the daughter nuclei; these droplets fuse to form the nucleolus. In the succeeding division either the whole nucleolar substance or most of it passes out into the cytoplasm, possibly carrying with it the specific gene enzymes (or enzyme products) of the mother-cell. The thread of the daughter-cell develops again in the same manner. The development of the thread at the expense of the nuclear sap naturally necessitates a flow of substance from the cytoplasm into the nucleus. The marked increase of the size of the nucleus during prophase is an indication that such a flow actually happens.

Although in the above discussion I endeavoured to prove that the evidence put forward in favour of direct transference of nucleolar substance to the developing spireme is conflicting and some of it is disputable, I wish here to emphasise the fact that I have not altogether excluded the possibility of the nucleolus, in certain cases, helping in the formation of the chromosomes indirectly.

Polyploidy in Rumex.

The present tetraploid form of *R. scutatus* var. *typicus* is the first of its nature in *Rumex*. The genus is well known for its extended polyploid series. In the section *Lapathum* the fundamental number is 10, e.g., in *R. alpinus*, *R. sanguineus*, *R. salicifolius*, etc., and species with 20, 30, 40, 50, 60 and 100 as haploid number of chromosomes have been found (Kihara and Ono, 1926). In the *Acetosa* section polyploidy has not been recorded. The section has two fundamental haploid numbers: 10, which exists in all the apogamous species, and 7, 8, which exists in the dioecious plants. *R. scutatus* belongs to the apogamous plants of the *Acetosa* section; its chromosome number has been determined by four different workers and found to be $2n = 20$ (Noda, 1926; Kihara and Ono, 1926; Jaretsky, 1928). The present plant belongs to *R. scutatus* var. *typicus*; it agrees in its morphological character with the botanical description of the species, and so far it does not seem necessary to give it a new specific name.

How far the doubling of chromosome number has affected the shape or the size of the plant is very difficult to say. Very little is known of the history and source of the plants from which this material was collected. They have been growing at Kew for three years, and are said not to have set seeds; they are perennials. It is my intention to continue the study of pollen formation in these plants, in the hope that this will throw light on the question of seed setting. An examination of the various types of *R. scutatus* in the herbarium of the Natural History Museum shows that this species is subject to wide variation in size and in form. There are forms with small leaves and dwarf plants, others of about the same size as those of the present plants, and others larger still. If the present tetraploid form appeared as a mutant from a diploid one, it is difficult to say whether the doubling of chromosome number has been accompanied by a change in the size of the leaves or other organs of the plant so long as the form from which the present plant has mutated is not known.

A comparison between the size of the nucleus of the present form and that of the diploid form studied by Kihara and Noda is also not possible.

It has long been maintained that the size of the nucleus or the volume of chromatin or the volume of cytoplasm bears a certain relationship to the chromosome number in a polyploid series. Thus Gates (1909) has shown that in the tetraploid *Oenothera gigas* the volume of the nucleus as well as the cells is about twice that of the diploid *O. Lamarckiana*. Belling (1923) finds that in polyploid *Daturas* the pollen mother-cells at the reduction division have a volume of cytoplasm nearly proportional to the number of complete haploid groups of chromosomes which they contain. According to Belling, there is also a proportional increase in the volume of the pollen grains. Ferguson (1926), in her cytological study of the *Aloinae*, finds that a comparison of the volume of chromatin in diploid and tetraploid species in *Haworthia* shows that tetraploidy is a result of the duplication of the complete chromosome set of the nucleus.

The pollen grains of certain polyploid *Rumex* species afford another illustration. Kihara and Ono (1926) measured, in water, the volumes of the pollen grains of *R. alpinus* ($n = 10$), *R. obtusifolius* ($n = 20$), and *R. crispus* ($n = 30$), and found that their size increases with chromosome number.

According to Jaretsky (1928), the number of chromosomes in Polygonaceae is not always proportional to the size of the nucleus, comparison being made between nuclei at exactly the same stages in different tissues. Not infrequently diploid nuclei are observed which in size resemble tetraploid or even hexaploid ones. In these cases Jaretsky maintains that we are probably dealing with a secondary or "masked" polyploidy (verkappte Polyploidie). In other words, the haploidy is only in the number of chromosomes, and it arose through fusion of the homologous chromosomes of a tetraploid form. Such a masked polyploidy could only be revealed by referring to what Jaretsky calls the *basic or fundamental chromosome size*.

According to this hypothesis, a species containing the same number of chromosomes as another belonging to the same genus, and whose chromosomes are larger than the latter, is really a polyploid form in which polyploidy has been masked by the fusion, individually, of the chromosomes of one set with those of one or more other sets. Degrees in this fusion of chromosomes could be seen in several cases in the plant kingdom. Thus there are plants in which the fusion of chromosomes is manifested only in the pollen mother-cells, while the somatic cells possess the polyploid number of unfused chromosomes. An extreme case is that of *Bunias orientalis*, in the pollen mother-cells of which Jaretsky finds seven gigantic chromosomes, while the root-tips contain 42 small ones. The volume of the nucleus in the pollen mother-cells is equal to that of the somatic cells. Jaretsky's deduction is that the entire plant is hexaploid, and that during reduction division the equivalent chromosomes fuse, giving rise to seven large ones. This fusion, which takes place in this case during reduction division only, is due to an affinity between the equivalent chromosomes, an affinity which is overcome, during somatic division, by an inhibiting factor whose activity increases in somatic mitosis. A completely masked polyploid form, according to Jaretsky, is simply a step further towards persistent fusion than *Bunias*, i.e., a form in which aggregate chromosomes persist, not only in pollen mother-cells but also in somatic cells. Jaretsky looks upon forms belonging to a polyploid series which possess chromosomes larger than the basic chromosome size demands as masked polyploids, the chromosomes of all the vegetative and reproductive cells of which are aggregate ones. The relationship between *R. acetosella* and *R. acetosa* affords an interesting case in this respect. According to several workers (e.g., Strasburger), *acetosella* ($2n = 41, 42$) arose from *acetosa* ($2n = 15$) by transverse division of chromosomes. In opposition to this view, Jaretsky holds that *acetosa* arose from *acetosella* by fusion of chromosomes. The haploid nucleus of *R. acetosella* with 21 chromosomes has the same size as that of forms, like *R. dentatus* and *R. maritimus*, which have 20 chromosomes. The nucleus of these species, again, is twice as large as that of forms which possess 10 chromosomes of normal size. *Acetosella* would therefore be a tetraploid form, while *acetosa* would be a still higher polyploid form.

Jaretsky's study of the root-tips of the diploid *R. scutatus* var. *glaucus* contains certain interesting observations and interpretations which might possibly throw some light on the behaviour of chromosomes in the pollen mother-cells of the present tetraploid form. The inhibiting factor of Jaretsky (*vide supra*) comes into play in the diploid *scutatus* plants. During reduction division this factor barely shows its effect; the chromosomes lie side by side in pairs. In somatic cells, on the other hand, there is no pairing; at metaphase the chromosomes lie single and scattered in the nuclear plate. Tetraploid nuclei were also observed by Jaretsky in the root-tips of his diploid form. In these nuclei the chromosomes at metaphase are strictly in pairs, the members of one pair lying exactly side by side, and are similar

in size and form. In the diploid form during mitosis the attraction between each paternal and maternal chromosome is not strong enough to induce pairing; it is inhibited by the factor. In the tetraploid nucleus pairing is induced by the attraction between the equivalent chromosomes, the members of each pair being both either paternal or maternal.

Gates's view of the pairing of chromosomes is slightly different from Jaretsky's. According to him, the absence of pairing in somatic mitosis is due to weak or to no attraction between the homologues. In meiosis, on the other hand, the attraction is considerable. In *Oenothera*, Gates describes species which, although each possessing a certain number of pairs in diakinesis and metaphase of pollen mother-cells, yet in somatic division exhibit either no pairing or no constancy in the number of pairs formed.

Let us now apply Jaretsky's hypothesis of inhibiting factor to the pollen mother-cells of the present tetraploid form. We have seen that in the diploid form the attraction between the equivalent chromosomes (in tetraploid nucleus) is stronger than that between a paternal and maternal chromosome, and that this attraction is so great that it could resist the inhibiting action of the factor during mitosis. It therefore follows, if such hypothesis be correct, that the chromosome pairs in the meiosis of the present tetraploid form are composed of equivalent chromosomes and not of paternal and maternal ones.

Several cytological observations and genetical assumptions support this deduction. It is maintained by the majority of cytologists that chromosome pairing in nuclear division is due to the attraction between the homologues. Chromosomes homologous only along parts of their length pair and fuse along those parts only, as is the case in *Tulipa* and *Hyacinthus* (Newton and Darlington, 1929).^{*} In *Oenothera*, on the other hand, there are extremely heterozygous forms in which there is no chromosome pairing whatever; such forms have no homologous chromosomes.

From the above it follows that in a tetraploid form of a certain diploid species one of the following arrangements of chromosomes would take place during division, no matter whether tetraploidy has arisen through association of four haploid chromosome sets or through the transverse division or longitudinal splitting of the univalent chromosomes.

First, the formation of quadrivalent chromosomes as in true tetraploidy † where the four chromosomes are equally attracted to each other, i.e., the attraction between a paternal and a maternal homologue, is equal to that between two paternal and two maternal equivalents. The tetraploid form of *Datura* of Belling and Blakeslee (1924) is an illustration of this arrangement. From a study of the behaviour of the offspring of this tetraploid form these authors find that "since the general Mendelian results agree with expectation on the hypothesis of random assortment of the four

^{*} Quoted by Darlington, 1929.

† The terms *true tetraploidy* and *double diploids* are Belling's.

chromosomes of a quadrivalent, it follows, since each quadrivalent usually consists of two connected pairs, that the coming together of the members of these pairs must have been at random."

Secondly, the formation of double pairs as in *double diploids*, where there is a sort of preferential attraction between the chromosomes forming a pair. Belling and Blakeslee (1924) describe a certain form of *Datura* in which there is genetical evidence of such preferential attraction.

Thirdly, the formation of pairs. If the attraction between the pairs (not between the two chromosomes constituting a pair) in double diploids gets weaker and weaker, until it disappears entirely, the chromosomes will now lie in pairs only, and there will be two sets of pairs of chromosomes. If the size differences between the chromosomes of the haploid set are sufficient to make them distinguishable from each other, there will be four recognisable repetitions of each size. If, on the other hand, the size differences are not sufficient, the whole tetraploid complex would appear in pairs just as in the diploid form, but with double the chromosome number. This is most probably the state of affairs in the present tetraploid form of *Rumex scutatus*. If homology of chromosomes means—as has been shown above—stronger attraction and more tendency to pairing, it seems much more likely that in the case we are dealing with now the members of each pair are *equivalent* chromosomes (i.e., either both paternal or maternal) which are strictly homologous. By pushing this argument a step further, we will probably arrive at the origin of the masked polyploidy of Jaretsky. If the attraction between the equivalents becomes so strong that intimate pairing and subsequent permanent fusion take place, the number of chromosomes will now be reduced to the diploid, and we will be left with a "masked tetraploid" which contains the diploid chromosome number.

SUMMARY.

1. The plants worked upon are a tetraploid form of *Rumex scutatus* var. *typicus*, in which $4n = 40$.
2. The spireme is not continuous, and there is evidence of parasynaptic pairing during heterotypic prophase.
3. A weak form of polarisation of the nucleus is described.
4. Pairing and shortening and thickening of threads proceed more or less together, and are extended over a fairly long period. This stage has been called "zygonema pachynema."
5. After pachynema, segmentation and splitting of the double thread take place more or less concurrently; but while the first most probably begins earlier, the second is extended over a longer period.
6. A "diffuse" stage similar to that which occurs in certain animals before diakinesis is described.
7. In diakinesis and in metaphase the chromosomes are arranged strictly in pairs, there being no fusion between the homologues to form bivalents.

8. The members of each pair are most probably *equivalent* chromosomes, i.e., both are either paternal or maternal in origin. This conception is considered at length in the discussion under Polyploidy.

9. The chromosomes are of different sizes, but the differences are not sufficient to make it possible to arrange the chromosomes into size-groups. Two pairs of extra large chromosomes are always recognisable; one of these is usually connected with another (small) pair to form a ring.

10. Cases of single non-disjunction have been noticed.

11. The homotypic split appears only in heterotypic telophase.

12. There is no evidence that the nucleolus contributes material, either directly or indirectly, to the formation of the chromosomes. During early prophase there is an increase in the size of the nucleolus, followed by a gradual decrease from early diakinesis to multipolar spindle.

13. A new conception of the "chromatinisation" of the thread is discussed. According to this conception, the spireme is self-forming—that is, the agent for chromatinisation lies in the leptotene linin thread.

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EXPLANATION OF PLATES.

All the figures are drawn with a camera-lucida at table level. They were all drawn under 2 mm. immersion Zeiss apochromat (N.A. 1.40) with Zeiss compensating oculars 20 and 30. All figures are drawn with the 30 oculars and are magnified 4,950 times, except figs. 1, 2, 3, and 21, which are drawn with 20 oculars and are magnified 3,300 times.

PLATE I.

- Fig. 1.—Pre-meiotic late telophase. The middle wall is not yet laid down between the two daughter nuclei. $\times 3,300$.
 Fig. 2.—*b*, a resting pollen mother-cell. *a*, a stage earlier.
 Fig. 3.—Leptonema. Thread single and univalent.
 Fig. 4.—Zygonema. *a*, regions where the double nature of the thread is still apparent. *b*, a thread not united with the same thread throughout its entire length.
 Fig. 5.—A piece of thread from a nucleus in zygonema showing two univalent threads widely separated for some distance and then merged into a thick double thread.
 Fig. 6.—First contraction: a form of weakly polarised nucleus.
 Fig. 7.—Second contraction: a polarised nucleus.

PLATE II.

- Fig. 8.—Second contraction (another form, not polarised).
Fig. 9.—*a*, two univalent threads just about to pair. *b*, a thick bivalent thread in the same nucleus in the zygonema-pachynema stage.
Fig. 10.—Pachynema.
Fig. 11.—Segmentation of the spireme. Splitting has also begun. *a*, thread with split just showing. *b*, threads in which univalents have already separated.
Fig. 12.—Diplonema.
Fig. 13.—“Diffuse stage.”

PLATE III.

- Fig. 14.—“Diffuse stage.”
Figs. 15 and 16.—Pairing threads. *a*, bivalent threads in which a twist is still apparent. *b*, bivalent thread showing a tighter twist. *c*, bivalent threads, the fused portion of which shows no twist.
Fig. 17.—Bivalent threads splitting into univalents.

PLATE IV.

- Fig. 18.—Diakinesis. Nucleolus and nuclear membrane not shown.
Fig. 19.—A stage slightly earlier than 18.
Fig. 20.—Diakinesis (nuclear membrane not shown), showing two rings of three chromosomes each. Ring *a* is in upper focus; ring *b* is in low focus and lies under other chromosomes.
Fig. 21.—Diakinesis. $\times 3,300$.
Fig. 22.—Multipolar spindle.
Fig. 23.—Metaphase: polar view.
Fig. 24.—Early anaphase. Polar view fixed in Carnoy modified.

PLATE V.

- Fig. 25.—Early anaphase. Polar view fixed in Carnoy modified.
Fig. 26.—Middle anaphase. Polar view. The chromosome sets are drawn separately to avoid confusion. Set *a* contains 21 chromosomes, set *b* 19 chromosomes.
Fig. 27.—The same. *a*, non-disjoined pair going to the top pole.
Fig. 28.—Late anaphase, oblique view.
Fig. 29.—Anaphase. Side view.
Fig. 30.—Late anaphase. Side view.
Fig. 31.—Telophase (top daughter nucleus cut). The chromosomes show the homotypic split.

PLATE VI.

- Fig. 32.—Early diakinesis. Chromosomes represented in two lots to avoid confusion, nucleolus and nuclear membrane not represented.
Fig. 33.—Stages in chromosome formation.
Fig. 34.—Different shapes of chromosome pairs.
Fig. 35.—Rings of four chromosomes, two large and two smaller ones; the connection between the two pairs is not persistent, and is shown to be either shifted or absent.
Fig. 36.—Pairs of large chromosomes. In each nucleus there are usually two large pairs of chromosomes, one pair of which is connected with another smaller pair to form a ring.
Figs. 37 and 38.—Rings of four chromosomes in diakinesis.

XIX.—THE OTOLITHS OF SMALL EELS FROM THE RHINE.

By A. GANDOLFI HORNYOLD, D.Sc., F.R.M.S.

(Read November 19, 1930.)

TWO PLATES.

IN the Journal of the Royal Microscopical Society, September, 1927, I published a paper on the otoliths of some large eels from the Rhine, showing considerable differentiation in the general form, as also in that of the sulcus.

I have continued my work on the eel of the upper Rhine at Augst, and have noticed that even the otoliths of small eels can show considerable differentiation.

The following table gives the length, weight, and dimensions of the saccular otoliths of these small yellow females.

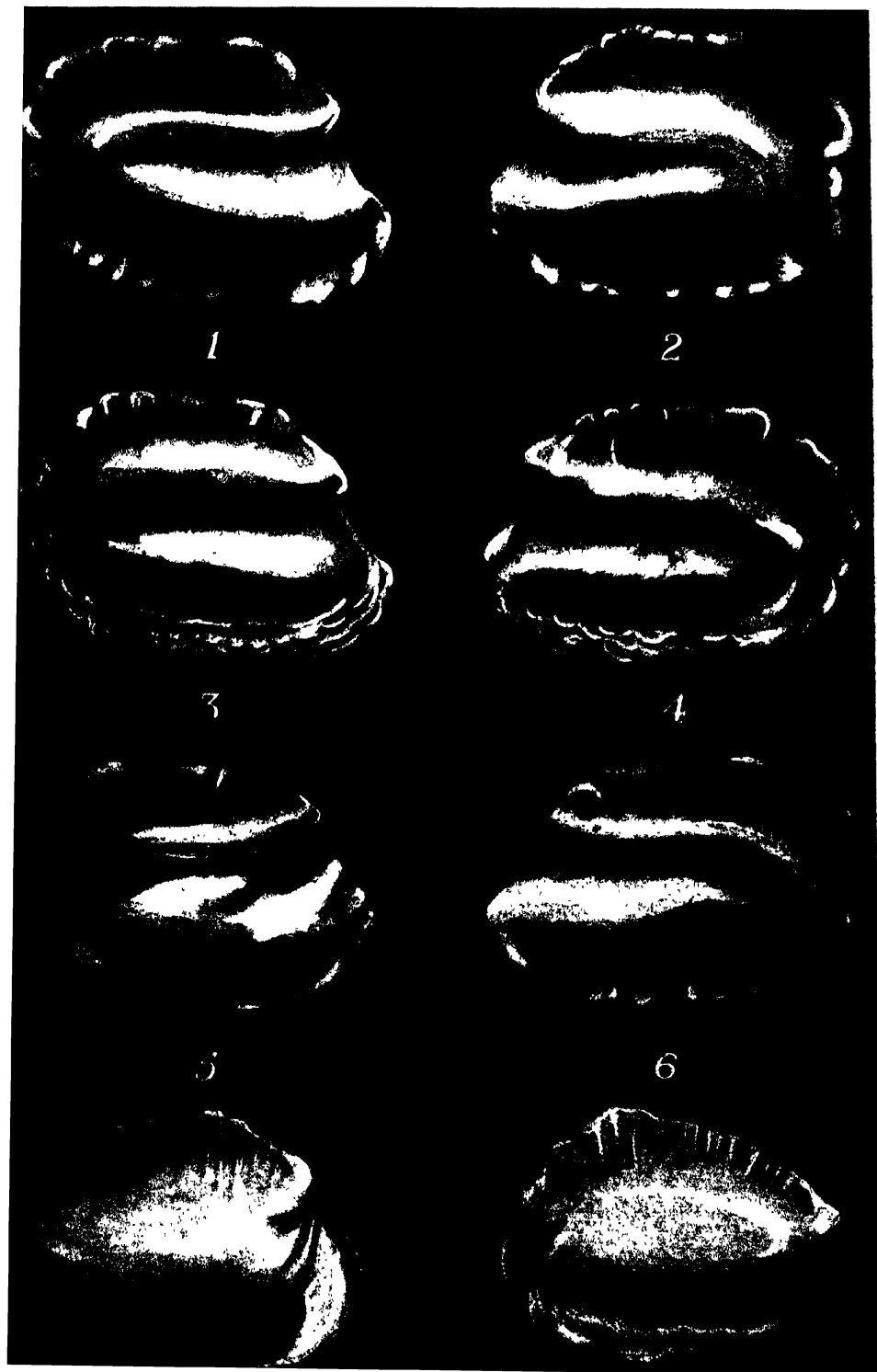
Length cm.			Weight gr.		Dimensions of Otoliths mm.			
41	..	63	Fig. 1.—Left	2.5 × 1.8	Fig. 2.—Right	2.5 × 1.8	× 24	
37	..	61	„ 3.—	2.3 × 1.6	„ 4.—	2.3 × 1.6	× 26	
35	..	56	„ 5.—	2.0 × 1.4	„ 6.—	2.1 × 1.4	× 28	
35	..	55	„ 7.—	1.8 × 1.4	„ 8.—	1.8 × 1.4	× 30	
34	..	55	„ 9.—	2.2 × 1.5	„ 10.—	2.3 × 1.5	× 26	
33	..	50	„ 11.—	2.1 × 1.6	„ 12.—	2.1 × 1.6	× 27	
33	..	42	„ 13.—	2.0 × 1.5	„ 14.—	2.0 × 1.5	× 28	
29	..	34	„ 15.—	1.8 × 1.3	„ 16.—	1.8 × 1.3	× 24	

Except in two cases both the otoliths were of the same size, and in both cases the right otolith is very slightly larger than the left (figs. 6 and 10).

The drawings were made by M. Fernand Angel, Assistant of the Musée national d'Histoire naturelle, and I thank him most sincerely for all the pains he took to render the otoliths as perfectly as possible, which is by no means an easy task.

The left otolith of the 41 cm. eel (fig. 1) is elongated, the dorsal rim is nearly straight, the ventral curved, and the posterior rim ends in a protuberance with a large notch below: antirostrum small and rounded, excisure present, rostrum very large and rounded. The wide, straight, undivided sulcus opens out widely on dorsal part of rostrum and ends rounded at about three-quarters of the length of the otolith. There is a ridge on the dorsal side of the sulcus which is also the deepest part, and the ventral side slopes down gradually.

The right otolith (fig. 2) is less elongated, the dorsal, ventral and posterior rims are more or less curved and indentated. The antirostrum is small and rounded, excisure present, and the rostrum is very large and blunt. The wide, straight, undivided sulcus opens out widely on dorsal side of rostrum



and ends rounded at about three-quarters of the length of the otolith. Part of the dorsal, the ventral side and the end slope down gradually, so that the greater part of the sulcus is shallow.

The left otolith of the 37 cm. eel (fig. 3) is elongated, the dorsal and ventral rims are straight, and the posterior rim ends in a protuberance. The surface has many indentations, especially towards the ventral rim, but less towards the posterior and the rostrum. Antirostrum small and rounded, rostrum large and obtuse. Excisure present. The sulcus is very wide and straight, opening widely on to the dorsal side of rostrum, it covers the greater part of the otolith, and is divided longitudinally by a ridge. The sulcus ends rounded at about five-sixths of the length of the otolith.

The right otolith (fig. 4) is elongated, both the dorsal and ventral rims are slightly curved, and the posterior rim is rounded with three notches. There are a few indentations on the surface towards the ventral rim and rostrum, but none towards the posterior rim. Antirostrum fairly large and rounded, excisure present, rostrum large and blunt. The wide straight sulcus ends rounded at about five-sixths of the length of the otolith. It is also divided by a longitudinal ridge, which, however, does not reach to the end of the sulcus. The sulcus is slightly narrower than in the left otolith, but its opening covers the whole of rostrum and frontal rim.

The left otolith of the 35 cm. and 56 gr. eel (fig. 5) is elongated, the dorsal and ventral rims nearly straight, and the posterior rim is flattened. Antirostrum a small point, excisure present, rostrum large and obtuse. The sulcus is wide, slightly oblique, undivided, and opens widely on to the frontal rim and rostrum, ending rounded at about five-sixths of the length of the otolith. The sulcus is very uneven, with very deep parts near dorsal side and very shallow, sloping down, on ventral side.

The right otolith (fig. 6) is elongated, the dorsal and ventral rims are rather more curved than in the left otolith, but the posterior rim is also flattened. Antirostrum and excisure barely indicated, rostrum large and rounded. The wide straight sulcus opens out widely on dorsal side of rostrum; it is very uneven, sloping down on the greater part of the ventral side, which is very shallow. The sulcus is undivided, and ends about five-sixths of the length of the otolith rounded.

Both the otoliths of the 35 cm. and 55 gr. eel (figs. 7 and 8) are quite irregular, their form is ovate, and there is no sulcus. The dorsal rim is curved, the ventral nearly straight, and the posterior rim is flattened and oblique. The left otolith has a small rounded antirostrum and a large blunt rostrum, excisure present. The right otolith has neither antirostrum, excisure nor rostrum.

The left otolith of the 34 cm. eel (fig. 9) is elongated, the dorsal rim is straight, the ventral curved, and the posterior ends in a protuberance. Antirostrum small and rounded, excisure present, rostrum large and blunt. The wide, straight, undivided sulcus opens out widely on the frontal rim, and ends rounded at about three-quarters of the length of the otolith. The

dorsal side of sulcus is deep, the ventral slopes down gradually, and the sulcus is not very sharply delineated.

† The right otolith (fig. 10) is elongated, the dorsal and ventral rims are curved, and the posterior rim ends in a protuberance with two notches below. There is neither antirostrum nor excisure, and the rostrum is large and rounded. The straight, deep, undivided sulcus opens out widely on to the frontal rim and rostrum, and ends rounded at about two-thirds of the length of the otolith.

The left otolith of the 33 cm. and 50 gr. eel (fig. 11) is elongated, the dorsal and ventral rims are curved, and the dorsal flattened. Antirostrum small and pointed, excisure present, rostrum small and rounded. Sulcus very wide and covering most of frontal rim and ending rounded at about three-quarters of the length of the otolith. A longitudinal ridge runs along the ventral side of sulcus, dividing it towards the rostrum.

The right otolith (fig. 12) is elongated, the dorsal rim is curved, the ventral straight, and the posterior rim rounded. Antirostrum small and pointed, excisure present, rostrum obtuse. The sulcus opens irregularly, covering the whole frontal rim, and it is divided into ostium and cauda ending rounded at about three-quarters of the length of the otolith. A ridge runs along the dorsal side, and the ventral slopes down. The sulcus is not sharply delineated.

The left otolith of the 33 cm. and 42 gr. eel (fig. 13) is elongated, both dorsal and ventral rims are curved, and the posterior rim ends in a protuberance with a notch below. Antirostrum small and rounded, excisure present, rostrum large and obtuse. The sulcus opens very widely on the frontal rim, is undivided, and ends in a point at about five-sixths of the length of the otolith. There are two small ridges near the opening of the sulcus.

The right otolith (fig. 14) is ovate, the dorsal rim is curved, the ventral straight, and the posterior rim is slightly flattened with a small notch. Antirostrum large and pointed, excisure present, rostrum large and rounded. The sulcus opens out widely on to the frontal rim, is undivided, towards the end slightly curved, and ends rounded at about three-quarters of the length of the otolith. On the greater part the sulcus slopes down on the ventral side.

The left otolith of the 29 cm. eel (fig. 15) is ovate, the dorsal and ventral rims are curved, and the posterior is flattened and oblique. Antirostrum small and rounded, excisure barely indicated, rostrum large and obtuse. The deep narrow sulcus is undivided and slightly curved, ending rounded at about four-fifths of the length of the otolith. There are two ridges on the surface below the sulcus.

The right otolith (fig. 16) is ovate, the dorsal and ventral rims are curved, and the posterior is flattened and oblique. The deep narrow sulcus is rather more curved than that of the left otolith, it is undivided, and ends rounded at about five-sixths of the length of the otolith. There are small ridges on the ventral side of the sulcus.

If we compare the 16 figures, representing the left and right otoliths



9



10



11



12



13



14



of eight small yellow female eels measuring 29–41 cm., we can observe that no two otoliths, even those from the same eel, are identical, but all vary more or less either in their form or in that of the sulcus, or even in both. In some cases the irregularities are more or less similar in both otoliths, as in the case of the longitudinal ridge in the sulcus of the otoliths of the 37 cm. and 61 gr. eel, and their indentations on the surface and below the sulcus (figs. 3 and 4). Other examples are the sulcusless otoliths of the 35 cm. and 55 gr. eel (figs. 7 and 8), and the narrow deep-curved sulcus and flattened posterior rim of the 29 cm. eel. One could easily find other examples by comparing the figures. This paper shows that not only the otoliths of large eels can show very considerable variation, either in form or of that of the sulcus, or even in both, but that the otoliths of quite small eels can vary in the same manner.

XX.—HYRAX, A NEW MOUNTING MEDIUM FOR DIATOMS.

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(Read November 19, 1930.)

EARLY in my work on fossil diatoms I began going through that period of experimentation which practically all other diatomists have followed, namely, the search for a better mounting medium than Canada balsam. The index of refraction of this resin is so little above that of the silica of which the diatoms are composed that the resulting poor resolution is deplored by all workers.

I tried the mineral preparations described in the early volumes of the *Journal of the Royal Microscopical Society* and elsewhere, and finally abandoned them all, with a cemetery of crystallised and discoloured preparations to show for my efforts.

It then seemed that perhaps the natural gums and resins offered the most likely field for finding a suitable substitute, and several years were spent collecting these materials from wherever they could be obtained. California itself was a fruitful collecting ground because of the vast number of introduced species of trees and shrubs. Styrax, of course, was familiar, and had by that time displaced Canada balsam in my laboratory, but I hoped to find a better resin even than that. Several were found which were certainly as suitable as styrax, and a few were slightly superior, but not enough to prove exciting.

When about ready to settle down with styrax for good, I happened to be reading an article on the solubility of rubber and sulphur in aniline, and the thought occurred to me that perhaps these could be converted into a synthetic resin. A consultation of the literature on the subject disclosed that such a resin could be made. Already I had investigated the properties of some of the commercial synthetic resins, but with indifferent results.

My early aniline resins showed a very high index of refraction (about 1.80), and while somewhat more difficult to manipulate than the natural balsams, the advantage gained in resolution was worth the trouble. Consequently, the services of L. A. Penn and Paul Ruederich were enlisted, and they made numerous batches. Slides mounted during that period

(1925-1926) have kept perfectly thus far, but the resin had three disadvantages: (1) It was soluble only in the difficultly volatile aniline; (2) it possessed a strong yellowish brown colour; (3) it possessed a displeasing odour during the preparation of the slides. The material was noted in my work as A.F.S. because of its composition—aniline, formaldehyde, and sulphur.

We could not believe that we had at once accidentally hit upon the only synthetic resin suitable for microscopy or the best one. Consequently, a long series of experiments was begun and many different preparations were tested. Except for a few which are still under observation, by far the best which we have thus far made is the one we have noted as "Hyrax." This is a derivative of the common chemical naphthalene.

Methods of converting this crystalline substance into an amorphous resin are readily accessible in chemical literature, but my own preparations were strongly coloured. Messrs. Penn and Ruederich (Box 26, Associated, California) have so perfected the technique of manufacture, however, that they have produced a resin which possesses merely a pale straw colour. This is so slight that slides mounted therefrom are practically colourless.

My original test slides were mounted in October, 1926, and to date (May, 1930) they do not show the slightest evidence of decomposition or crystallisation. It is believed they will be permanent.

By using the method suggested by Conrad Beck in D. S. Spence's recent article in the *Journal*, a fairly satisfactory measurement of the refractive index of the hardened resin was obtained; this was found to be 1.82248, an average of four readings. (A sample of the resin has been sent to the Secretary of the Society, and it is hoped that some of the members, more experienced and better equipped than I, will undertake a redetermination of the index of refraction.)

Hyrax is soluble in benzene, xylene, and several other common organic solvents, but not in alcohol or water. The solvent is easily expelled with gentle heat, and, owing to the absence of such difficultly volatile substances as the terpenes of balsam, it does not tend to produce bubbles to such an extent. After the solvent is expelled, it will withstand an exceedingly high temperature without discolouration, and the odour is not unpleasant. The gelatin film used to cement the diatoms to the cover will scorch long before the hyrax will begin to lose its transparency. When hot, the resin is extremely fluid, and therefore displaces air from the objects being mounted very readily.

A few experiments have been made to find if the resin would cause any alteration of the colour of some of the common stains used in biology. Those tried were not changed in the slightest, but the research was not carried sufficiently far to warrant a general statement. The simple nature of the chemical, being neither acidic nor basic, should be in its favour.

Some test slides long exposed to sunlight seem to darken to about the

colour of old balsam, but those kept in slide cabinets have shown no such change and remain practically water white. The spectrum of the light transmitted has not been investigated, but it may be said that it is very transparent to the blue and violet rays, which is decidedly advantageous in photography.

REFERENCE.

SPENCE, D. S. (1929).—"A Method of Finding the Refractive Index of a Drop of Mounting Medium." *J. Roy. Micr. Soc.*, ser. 3, **49**, pt. 3, 224-8.

XXI.—MICROSCOPICAL STUDIES IN PERNICIOUS ANÆMIA. I.

By W. E. COOKE, M.D., F.R.C.P.E., D.P.H.,
and C. F. HILL, M.Inst.M.M., A.Inst.P., F.R.M.S.

(Read November 19, 1930.)

TWO PLATES.

THE HÆMOGLOBINIFEROUS CELLS.

WE are concerned, in these papers, with cells found in the blood stream in pernicious anæmia, but it may be well to recall a few features of normal hæmatogenesis. In early fœtal life the liver is the chief organ of blood production, but as bone marrow develops, from two months, the seat of formation is gradually transferred until at the end of the sixth month of intra-uterine life the marrow takes almost complete charge of this function. The type of hæmoglobiniferous cell arising in the liver and marrow is megaloblastic and indistinguishable from some of the megaloblasts found in these situations, in the hæmo-lymph glands and in the blood stream in pernicious anæmia. The megaloblast is a large cell measuring 20 or more microns in diameter, and has a vesicular or reticular nucleus. It becomes, eventually, a large non-nucleated hæmoglobin containing megalocyte.

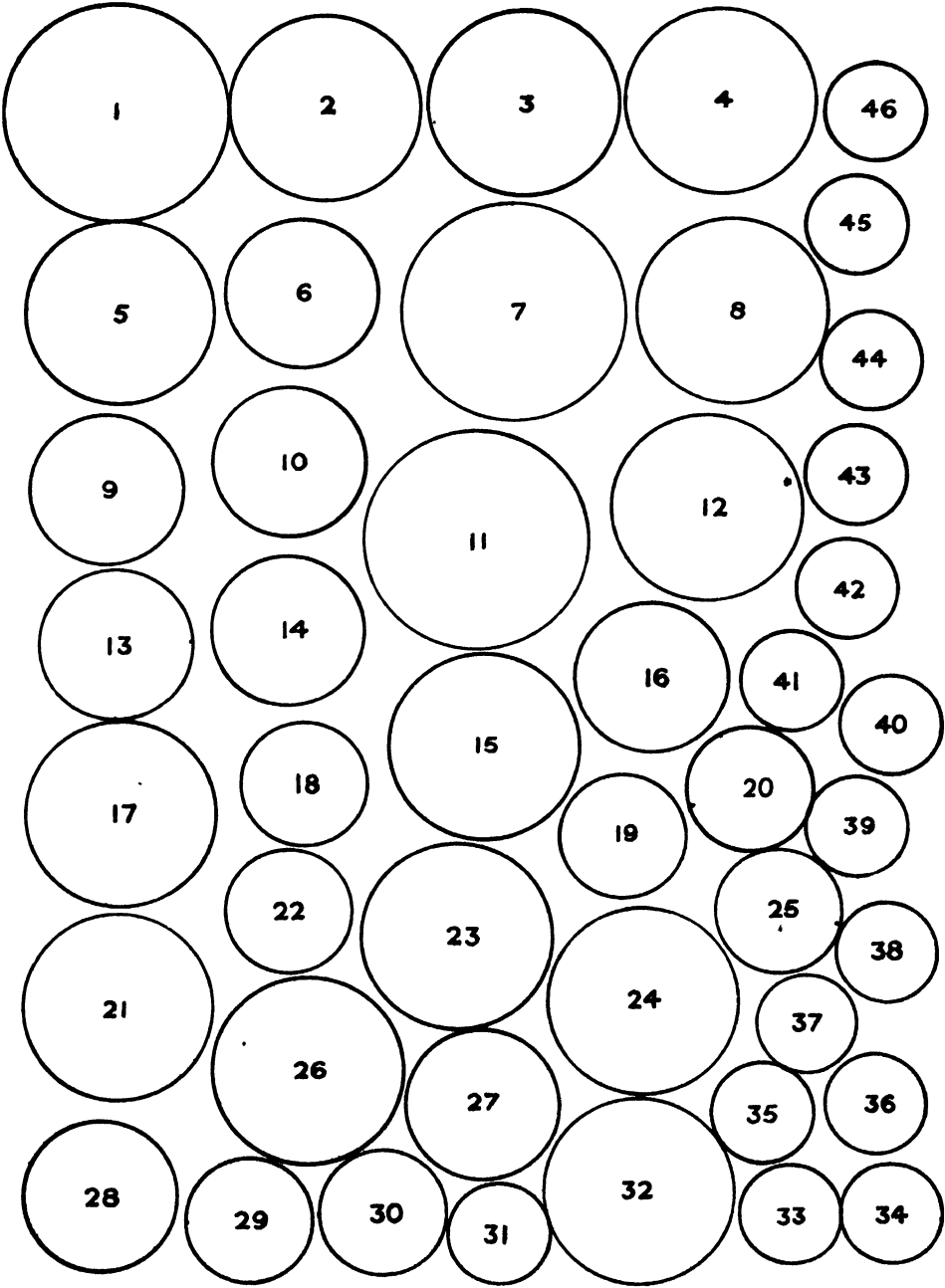
At the end of the fifth month of intra-uterine life erythrogenesis changes and becomes normoblastic in type and as such persists throughout post-natal life. The normoblast is a much smaller cell than the megaloblast, being little larger than a normal red corpuscle. The basichromatin of its nucleus is condensed and frequently presents a radial formation. The normoblast becomes the non-nucleated red corpuscle of the post-natal circulation. The points are mentioned because in pernicious anæmia reversion to embryonic type is attempted by not only the bone marrow but also by the liver and hæmo-lymph glands. This reversion is pathological, of course, and as cells are found in the blood stream which are not seen in embryonic life the manner of reverting is in itself abnormal.

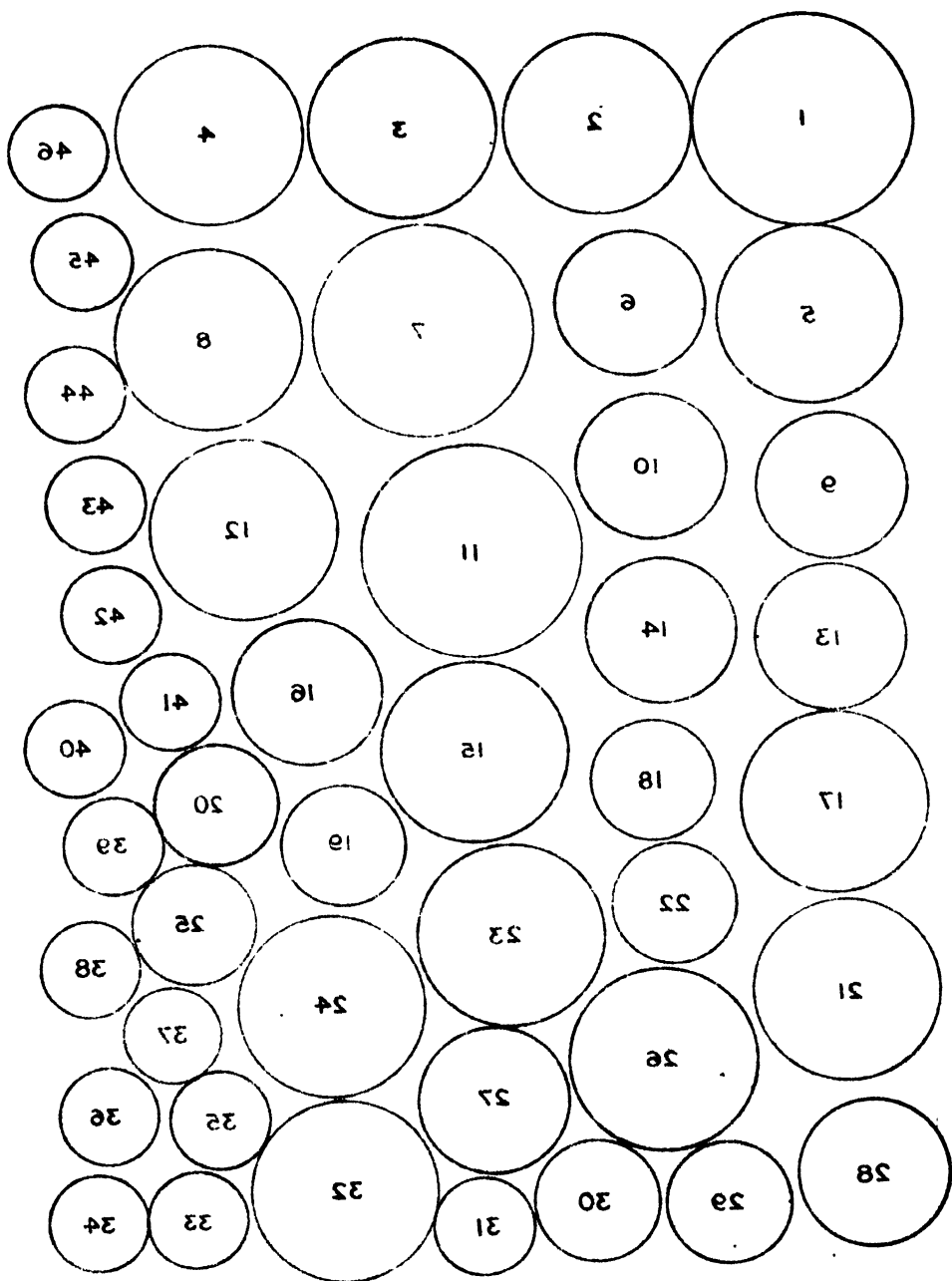
1. *The Erythroblast in Pernicious Anæmia.*—The term "erythroblast" is used in its widest sense to embrace every type of cell which has erythrocytic potential, and is destined to become a non-nucleated cyte of the blood stream. The presence of any nucleated red cell in the peripheral blood, except during the first few weeks after birth, is abnormal. In pernicious anæmia erythroblasts of all descriptions are common, and although it is possible to classify some as megaloblasts and others as normoblasts by

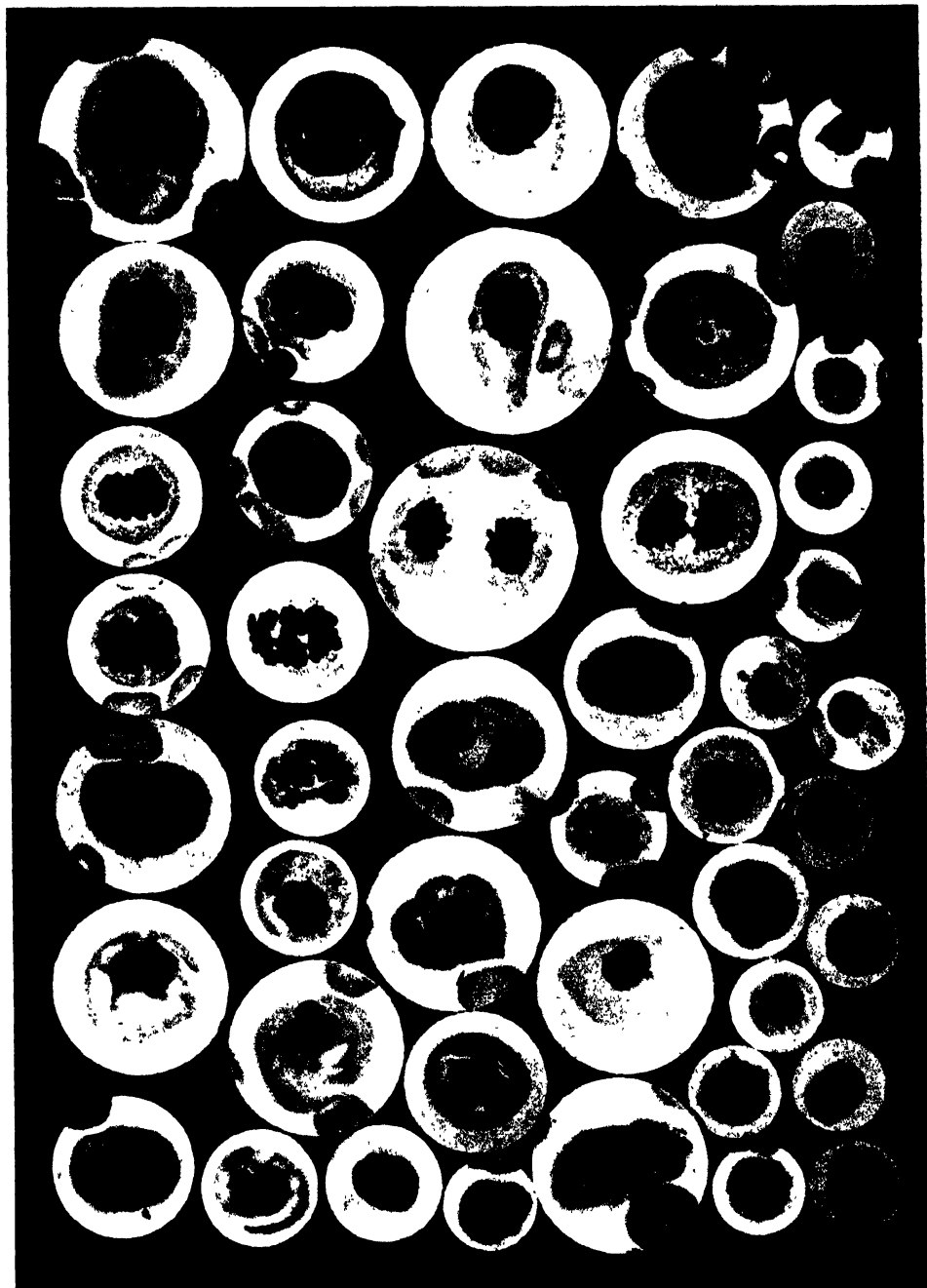
their nuclear structure, many cells are present which defy rigid placing. The photomicrographs in plates I and II illustrate this difficulty. All types, from the large megaloblasts of the first and second generations, the megaloblast not larger than a normoblast, the microblast and the poikiloblast with misshapen body, to the macro-normoblast and the normoblasts of normal size, are depicted, and indicate the impossibility of differentiation between these cells.

The statement that megaloblasts are present in the blood stream only in pernicious anæmia, and are pathognomonic of this disease, has been made so frequently that the anæmia is defined as a megaloblastic anæmia in many text-books on medicine. In our experience megaloblasts are found in conditions other than pernicious anæmia - von Jaksch's anæmia and acholuric jaundice, for example. The presence of the megaloblast merely indicates that, under abnormal stress or stimulus, a marrow hæmocyto blast has reverted to the production of erythroblasts of embryonic type, or that some extra-medullary hæmatogenic centre, normally in post-natal life quiescent, has been activated to perform its foetal function.

The erythroblast may enter the blood stream in any stage of its life-history. It is found as a first generation cell—a primary division of the hæmocyto blast having erythrocytic potential. The first generation cell is large, measuring 20, 30, or more microns in diameter, the nucleus is vesicular or reticular, the cytoplasm homogeneous and basophilic in varying degrees of intensity. In stained films the cytoplasm frequently shows a clear perinuclear zone due to contraction of the nucleus in fixation. Plate I, figs. 1, 2, 3, 4, 5, 6, and 10, illustrate first generation cells. These cells undergo mitosis in the blood stream, and are found in various stages of division illustrated by figs. 7, 8, 9, 11, 12, 13, 14, 15 and 16. Figs. 18 and 19 are daughter or second generation cells whose nuclei are in the process of reconstruction. After reconstruction of the nucleus, hæmoglobin commences to be formed in the cytoplasm, and shortly afterwards changes take place in the nucleus prior to its disappearance. The nucleus may undergo simple karyolysis, or pycnosis and karyolysis may proceed simultaneously, or a combination of pycnosis, karyorrhexis, and karyolysis may occur. Karyolysis is shown in plate I, figs. 17, 20, 21, 22, 24, 25, 26, 30 and 32, and in plate II, figs. 9, 22 and 23. Endolysis appears to proceed uniformly, and even in the late stages, as in plate II, figs. 22 and 23, nuclear structure is still visible. The second method of nuclear disappearance, by pycnosis and karyolysis, is illustrated by figs. 27, 28, 29, 33, 34 and 35 in plate I, and in figs. 1, 3, 8, 10, 16 and 17 in plate II. The basichromatin of the nucleus becomes aggregated into a deeply-staining mass showing little, if any, of the original structure. In the third method, pycnosis, karyorrhexis and karyolysis take place side by side. The nuclear membrane is lost early, the chromatin becomes clumped, and fragments are split off and scattered in the cytoplasm. These fragments gradually undergo endolysis and disappear. Pycnosis and karyorrhexis may take place at any stage. In the simplest form it is







illustrated by figs. 12 and 13 in plate II, but nuclear fragmentation not infrequently produces bizarre figures as in the cells 2, 4, 5, 6, 7, 10 and 11 in plate II. The cell in fig. 2 shows the process occurring in telophase. The first step in karyolysis, whether accompanied by pycnosis or karyorrhexis or both, would appear to be loss of the nuclear membrane. This suggestion is supported by the fact that nuclear particles are found in the cytoplasm before any evidence of pycnosis is apparent, as illustrated in figs. 23 and 24 in plate I and in a slightly later stage in fig. 5, plate II.

In normal erythropoiesis the already condensed nucleus of the normoblast, plate II, figs. 33 and 34, undergoes pycnosis and endolysis (plate II, fig. 13) in the marrow, and the red corpuscle enters the blood stream containing its full complement of hæmoglobin and without any trace of the nucleus.

2. *Nuclear Remains in Erythrocytes.*—Particles, undoubtedly of nuclear origin, are frequently seen in erythrocytes in pernicious anæmia. They stain in the same manner as nuclear material, and are visible in fresh preparations by dark-ground illuminations. These particles are* found in three forms, and may be present in orthochromasic or polychromasic cells. The first were independently described by Howell and Jolly, and are known as Howell-Jolly bodies. They appear in stained films as rounded structureless particles of varying sizes. They may be single, as in plate II, fig. 21, but more commonly two, three or more are present, as shown in figs. 18, 19, 20, 24, 25, 26 and 27 in plate II. Occasionally they are so numerous (plate II, figs. 14 and 15) that the condition may be mistaken for punctate basophilia. The second type of nuclear rest occurs in the form of rings or figures of 8, complete or incomplete. They were described by Cabot (1903). Plate II, fig. 30, illustrates a complete figure of 8 form, and figs. 31 and 32 incomplete forms. Cabot's rings are really chains composed of granules of chromatin, and may be minute aggregations on the nuclear membrane which for some reason have resisted lysis after the rest of the nucleus has disappeared.

The third type is seen in figs. 28, 29 and 32, plate II, and consists of irregularly-shaped particles of chromatin of varying sizes.

3. *The Erythrocytes in Pernicious Anæmia.*—The erythroblast, having lost its nucleus, becomes an erythrocyte, and it will be apparent, from the photomicrographs, these will show wide variations in sizes and shapes. This marked anisocytosis is a constant feature of blood films during relapses in pernicious anæmia. Megalocytes measuring up to 15 microns in diameter, microcytes as small as 2 microns, cells of normal size, misshapen cells or poikilocytes of all sizes, and what appear to be fragments of red cells, or schizocytes, compose the red cell picture. More than 45 years ago Laache (1883) insisted that the large size of the red corpuscle is an essential feature in pernicious anæmia. This contention has been upheld by many observers and supported by Price-Jones (1920, 1922 and 1924) by distribution curves of the diameters of red corpuscles in pernicious anæmia compared with curves of normal blood. His figures show the mean diameter of normal

erythrocytes to be 7.2 microns, with extreme variations between 5.5 microns and 9.5 microns. In pernicious anæmia the mean diameter is 8.6 microns, with extreme variations from 2 to 15 microns.

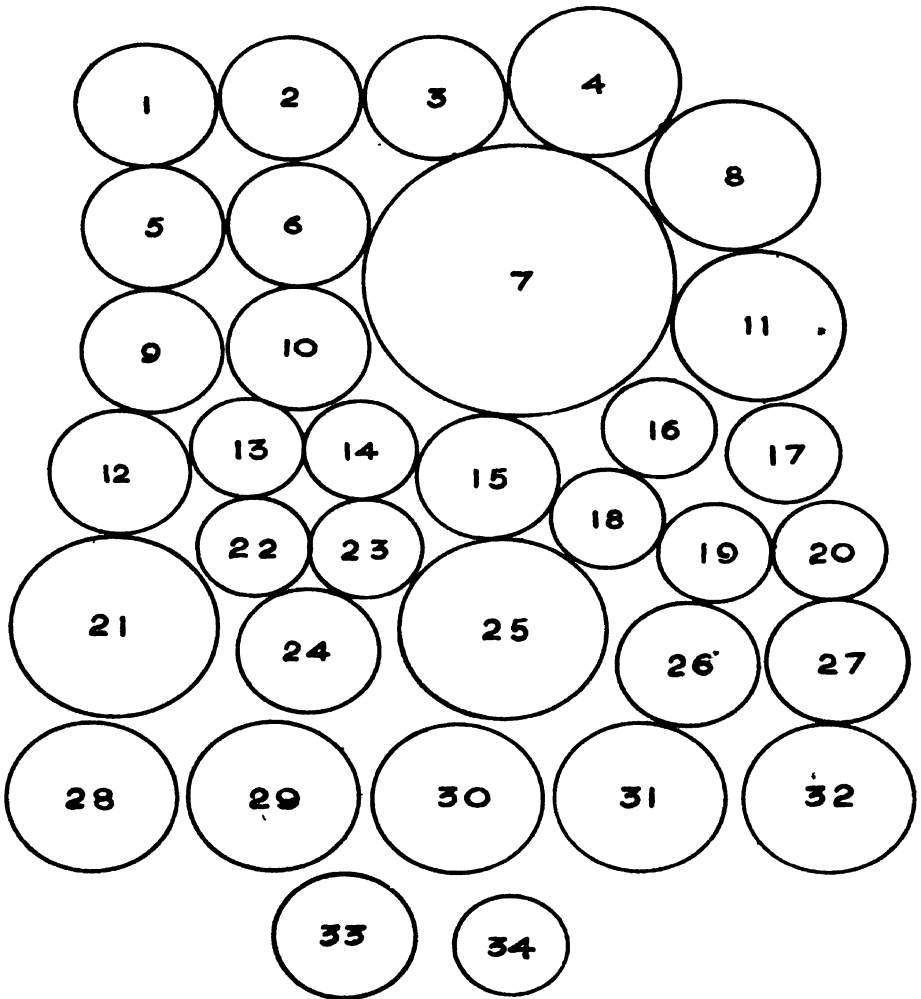
A characteristic of the large erythrocyte is ovality. Cornell (1927) found that 89 p.c. of all erythrocytes having a mean diameter greater than 7 microns were oval in shape.

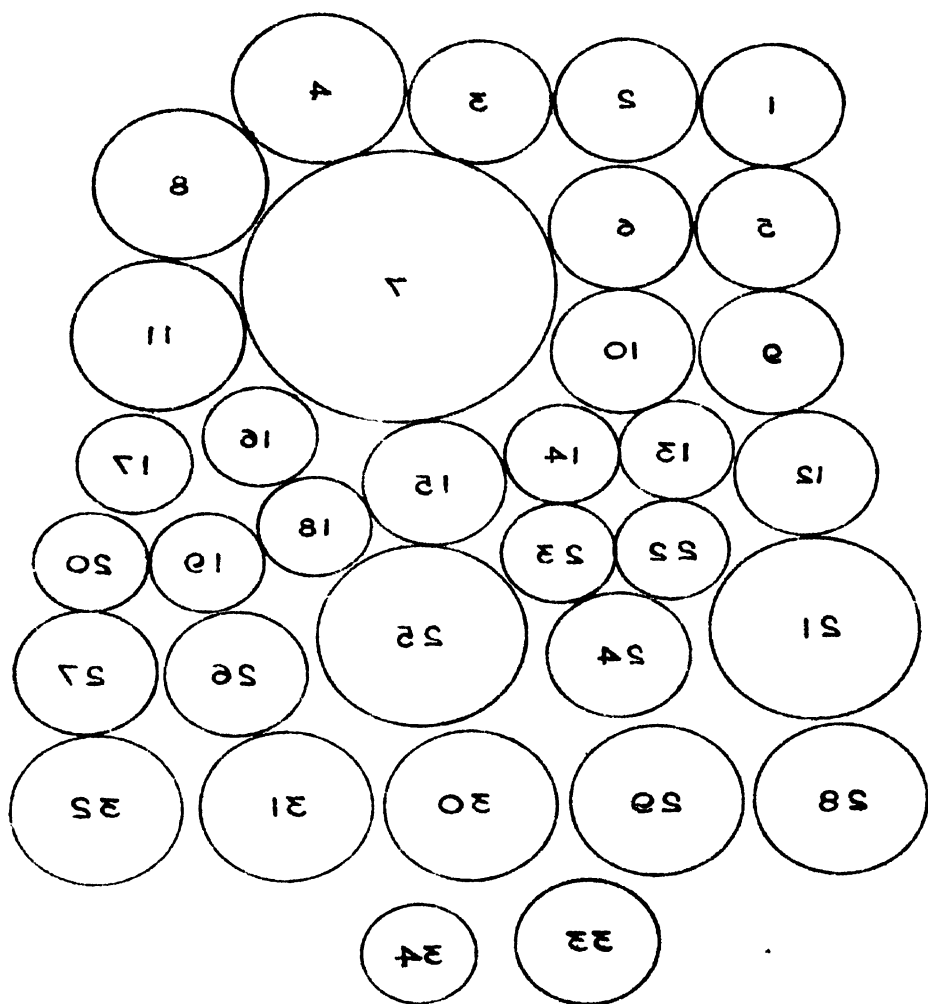
All the above measurements were taken from dried, fixed, and stained films.

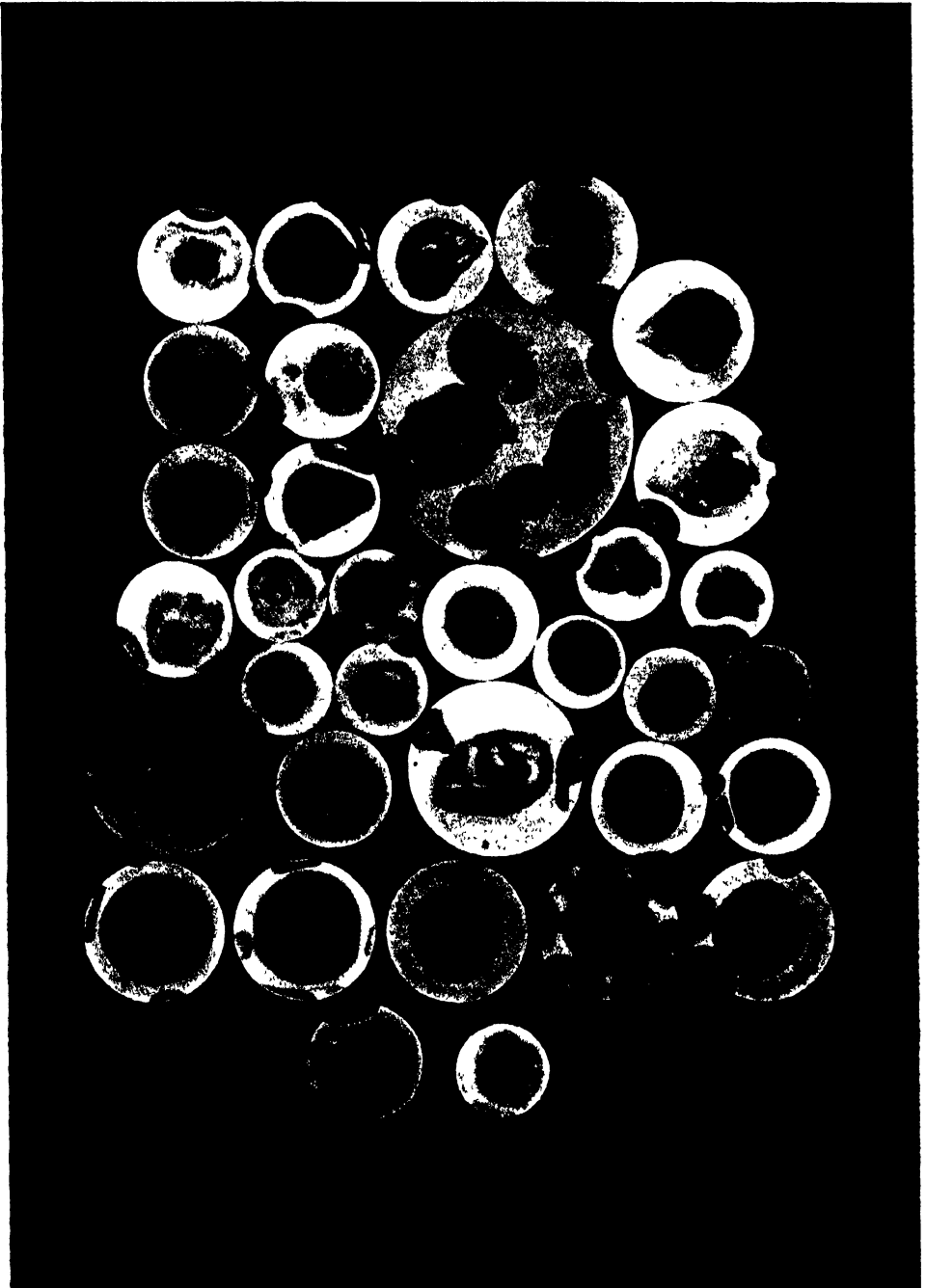
The average diameter of normal red cells measured in plasma closely approximating circulatory conditions was found to be 8.8 microns, and Ponder and Millar (1924) have obtained a numerical expression for shrinkage in dried films. They found that the value of the mean diameter of cells in the blood could be obtained by adding to the mean diameter of the dried corpuscle a quantity varying from 0.15 to 0.115 times that value. For example, if a dried cell measures 7.8 microns, its diameter in plasma would lie between 8.7 and 8.97 microns. The normal mummy has a definite relationship to the circulating corpuscle in health. But Murphy, Munroe and Fitz (1927) have shown the red cell in pernicious anæmia to be deficient in protein, and Whipple (1922) suggests the stroma to be defective. We cannot take for granted, then, that the dried cells bear the same ratio to the plasma corpuscles in pernicious anæmia as they do in health.

This chemical inadequacy probably explains four interesting phenomena which are present in marked relapses. The first, recorded by Peabody and Broun (1925), is the active phagocytosis of red corpuscles by the reticulo-endothelial cells of the marrow. They suggest that chemical alteration in the red cells is responsible. The second is the almost complete absence of rouleaux formation. This is probably partly due to a defect in the cohesive properties of the surface of the corpuscle. Other factors, such as the lessened probability of chance contact owing to the fewer numbers of red cells per unit volume, and marked inequality in sizes and shapes, also contribute. In contrast to lack of rouleaux formation, auto-agglutination is frequent. Agglutination of the red corpuscles often occurs at room temperature in a few seconds. The chemical defect may have a direct bearing on the reduction of the potential differences between the red cells which is considered to cause the phenomenon.

The fourth is the so-called endoglobular degeneration. In orthochromatic and polychromatic cells, nucleated or not, large or small, there appear in fixed and stained films pale areas or vacuoles in the cytoplasm. To this appearance the term "endoglobular degeneration" has been given. Plate I, figs. 21, 26, 27 and 29, and plate II, figs. 1, 3, 21 and 25, illustrate this condition. The stroma containing hæmoglobin appears to have contracted irregularly, with the result that spaces devoid of hæmoglobin have been produced. The outline of the cell may be wavy, as in plate I, figs. 21 and 26, and plate II, figs. 1, 4, 21 and 25. This fragmentation of the cytoplasm is a constant feature in pernicious anæmia. In films of normal blood the







erythrocyte appears homogeneous, and has a rounded edge which contains the bulk of the hæmoglobin. The pale central area contains little, if any, colouring matter. By dark-ground illumination this biconcave appearance is more or less fixed. Variations in shape do occur, but the cell returns to its original form. In pernicious anæmia the red corpuscles are not all biconcave; some appear biconvex and some almost globular in shape. Their contour has not the same rigid appearance as in normal blood, and it is not surprising to find in stained films uneven distribution of the cell contents. The vacuolation is due to the abnormal physico-chemical composition of the stroma, and cannot be described as a degeneration.

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DESCRIPTION OF PLATES.

PLATE I.

Figs. 1, 2, 3, 4, 5, 6 and 10 are photomicrographs of erythroblasts (megaloblasts) of the first generation. The vesicular or reticular character of the nucleus is seen, and the variations in the intensity of staining of the basophilic cytoplasm suggested by comparison with the nuclear staining.

Fig. 7 is a polar view of a spireme.

Figs. 8, 9, 13 and 14 illustrate erythroblasts in metaphase.

Figs. 11, 12, 15 and 16 are erythroblasts in late anaphase or telophase.

Figs. 18 and 19 are daughter or second generation cells whose nuclei are in the process of reconstruction.

Figs. 17, 20, 21, 22, 24, 25, 26, 30 and 32 illustrate the process of karyolysis.

Figs. 27, 28, 29, 33, 34 and 35 are examples of pycnosis and karyolysis.

Figs. 23 and 24 suggest that solution of the nuclear membrane has occurred and karyorrhexis and karyolysis are taking place. Fragments of chromatin have become separated from the main mass of the nucleus.

Figs. 36 to 46 are examples of unclassifiable erythroblasts ranging in size from a normoblast to the microblast.

Figs. 21, 26, 27 and 29 illustrate fragmentation of the cytoplasm, the so-called endoglobular degeneration.

PLATE II.

Figs. 1, 3, 8, 10, 16 and 17 are examples of pycnosis and karyolysis.

Figs. 12 and 13 show the simplest form of pycnosis and karyorrhexis.

Fig. 2 is an example of pycnosis and karyorrhexis occurring in an erythroblast in telophase.

Figs. 4, 5, 6 and 11 are examples of bizarre figures produced by pycnosis and karyorrhexis.

Figs. 3, 4, 8, 10, 11 and 16 are examples of poikiloblasts.

Figs. 9, 22 and 23 illustrate the final stages of karyolysis.

Fig. 7.—This field shows on the left an erythroblast whose nucleus is undergoing pycnosis, karyorrhexis, and karyolysis. Above this is an example of the ovality of megalocytes in pernicious anaemia, and on the right is a granular polychromatic erythrocyte. Anisocytosis is illustrated by the variation in size of the erythrocytes.

Figs. 14, 15, 18, 19, 20, 21, 24, 25, 26 and 27 illustrate the nuclear rests known as Howell-Jolly bodies occurring in orthochromatic and polychromatic erythrocytes.

Fig. 30 illustrates a complete Cabot's ring in the form of a figure of 8 in a polychromatic erythrocyte. A Howell-Jolly body is seen on the right of the ring, and the granular form of polychromasia is shown.

Figs. 31 and 32 are examples of incomplete Cabot's rings in granular polychromatic erythrocytes.

Figs. 28, 29 and 32.—In these figures the third type of nuclear rest is seen. Irregularly-shaped masses of chromatin varying in size are seen in polychromatic cytes. In figs. 28 and 29 the light areas contain haemoglobin.

Figs. 33 and 34.—Fig. 33 is a macronormoblast with polychromatic cytoplasm. Fig. 34 is a normoblast of usual size with orthochromatic cytoplasm.

Figs. 1, 3, 4, 21 and 25 illustrate fragmentation of the cytoplasm. In fig. 25 extreme variations in sizes and shapes of erythrocytes in pernicious anaemia are seen.

Fig. 6, on the left of the erythroblast, is a schizocyte.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

The Use of an Alizarin-Molybdic Acid Lake in Staining.—K. OKAJIMA ("Über die Färbemethode mit Alizarinmolybdänlack," *Folia Anat. Jap.*, 1926, 4, 411-12). Red blood cells, blood crystals, eosinophil granules stained by this method do not fade for years, even when exposed to sunlight. The material is fixed in formalin. Sections are washed and mordanted in a 10 p.c. aqueous solution of phosphomolybdic acid for from 30 seconds to 2 minutes. Wash and stain for from 20 minutes to 24 hours in 100 parts of saturated aqueous sodium alizarin sulphonate mixed with 30 parts of 10 p.c. aqueous phosphomolybdic acid. Wash, pass through the alcohols, xylol and mount in balsam. The aqueous solution is more permanent than the alcoholic. The staining agent is an alizarin-molybdic acid lake.
G. M. F.

The Staining of Frozen Sections.—B. W. RHAMY ("The Rhamy Triple Stain for Frozen Sections. I. Methods for Frozen Sections," *J. Lab. & Clin. Med.*, 1930, 15, 490-1). For temporary preparations: Place the cut sections in 4 p.c. formalin, float on the slide, and stain for from 10 to 15 seconds in eosin, saturated aqueous solution, 5 c.cm.; basic fuchsin, saturated alcoholic solution, 3-5 c.cm.; methylene blue, saturated alcoholic solution, 15 c.cm.; alcohol, 30 p.c., to 100 c.cm. This stain can be used fresh, but is better after 48 hours' ripening. It should be purplish blue in colour. For permanent preparations after staining, the sections are transferred to 96 p.c. alcohol till excess stain is removed (5 to 10 seconds). Transfer to absolute alcohol, carry through xylol, and mount in neutral balsam.
G. M. F.

The Rhamy Triple Stain for Frozen Sections.—B. W. RHAMY ("A Quick Method for Mounted Sections (24 hours)," *J. Lab. & Clin. Med.*, 1930, 15, 491-2). The same stain proposed for frozen sections may be used on celloidin sections by the following technique:—Fix in 5 to 10 p.c. formalin for 1 hour, then into two changes of acetone for from $\frac{1}{2}$ to 2 hours, according to the size of the specimen. Acetone, ether and absolute alcohol (equal parts) for from $\frac{1}{2}$ to 2 hours. Thin celloidin for from $\frac{1}{2}$ to 2 hours; thick celloidin overnight, mount and cut and stain sections as in the previous abstract. Epithelial cells are light blue, endothelial cells lavender, small round cells deep blue, connective tissue fibres pink, muscle fibres rose to magenta, mast cells dark blue with blue granules, heads of spermatozoa blue, connective piece dark red, tail pink.
G. M. F.

The Staining of Frozen Sections.—B. W. RHAMY ("The Rhamy Triple Stain for Frozen Sections. III. For Blood Smears and for Bacteria," *J. Lab. & Clin. Med.*, 1930, **15**, 492). The same stain may be used on blood smears or bacteria. After fixation in alcohol, the stain is applied for 1 minute; then the slide is washed in tap water, blotted and dried. Nuclei are blue with neutrophil cytoplasm pink, lymphocyte cytoplasm red to reddish blue, basophils as in Wright's stain. Negri bodies stain magenta with blue granules, nerve cells light blue. *B. typhosus* and the paratyphoid bacilli pink; *B. coli* and *B. dysenteriae* lilac; *B. diphtheriae* pink with lilac granules and bars; *B. influenzae* and *Leptothrix* colourless with lilac bars and granules; cocci blue, meningococci lavender to pink. G. M. F.

A Method for Separating Amphibian Embryos.—P. SLONIMSKI ("Sur un procédé simple pour décortiquer les embryons des amphibiens urodèles," *Bull. d'histol. appl.*, 1930, **7**, 44-5). By this method amphibian eggs, in all stages of segmentation, and embryos may be liberated from their albuminous envelope and membranes. The embryo is placed on Bristol-board and most of the gelatinous substance is removed with a Gillette razor blade. Thus prepared, the embryos are transferred to a piece of Bristol-board that has been soaked in paraffin and is smaller than the opening of the container which is to receive the specimen. The object is held with forceps, and a sharp stroke is made with a Gillette blade. If the embryos are not liberated instantly, the operation is carefully repeated. The paraffin coat on the cardboard prevents drying, and facilitates transfer of the specimen to the liquid into which it is to be introduced. G. M. F.

A Rapid Paraffin Method for Tissue Sections.—I. M. VILKOMERSON ("A New Rapid Paraffin Method for Tissue Sections," *J. Lab. & Clin. Med.*, 1929, **15**, 290-1). Tissues are fixed, embedded, cut and stained in from 3 to 4 hours, while the slides are permanent. Fix segments 2 mm. thick for $1\frac{1}{2}$ hours in wide-mouthed bottles in a mixture of 60 c.cm. absolute methyl alcohol, with 100 c.cm. acetone in which one or two iodine crystals have been dissolved. At the bottom of the bottle there should be a $\frac{1}{2}$ -inch layer of anhydrous copper sulphate covered by several ply of gauze, on which the tissue is placed. Transfer to chloroform for $\frac{1}{2}$ hour, then to 1 part chloroform, 1 part paraffin for 15 minutes, melted paraffin at 56°C . for 15 minutes, melted paraffin with attached vacuum apparatus for 15 minutes. Use an electric water bath which should not be more than 1°C . above the melting-point of the paraffin. Embed and cut as usual. G. M. F.

The Staining of Paschen Bodies.—H. WATANABE ("Beitrage zur Färbung der Paschenschen Körperchen (Elementarkörperchen)," *Zentrbl. f. Bakt. I. Abt. Orig.*, 1930, **116**, 291-4). Paschen's method of staining the bodies found in lymph which have been named after him was with Loeffler's mordant and carbol fuchsin; it can be improved by antiformin treatment after mordanting. Petagnani and Gianni's mordant for bacteria in tissues is also satisfactory providing methyl is used in place of absolute alcohol. Chromic acid is also a useful mordant. Smears are dried in air. The method with Loeffler's mordant is as follows:—Physiological salt solution, 10 minutes, dry; methyl alcohol, dry; steam with Loeffler's mordant; rinse in water; antiformin 0.3 p.c. for $\frac{1}{2}$ minute or 0.2 p.c. for 1 minute; rinse; stain with either carbol fuchsin 3 to 5 minutes, carbol methyl violet 15 minutes, saturated aqueous fuchsin or methylene blue solution 10 to 20 minutes. The method with the chromic acid mordant is:—(1) Dry and flame the smears; 5 p.c. chromic acid 10 to 30 minutes; rinse; 0.3 p.c. antiformin about 1 minute; rinse; carbol fuchsin or carbol methyl violet 5 to 10 minutes; rinse. Antiformin enables

a greater variety of dyes to be used for staining than the original method. The Paschen bodies seem larger, clearer, and sometimes are surrounded by light areas.
G. M. F.

The Rapid Diagnosis of Cancer.—C. F. GESCHICKTER ("Fresh Tissue Diagnosis in the Operating Room," *Stain Technol.*, 1930, 5, 81-6, 1 text-fig.). The disadvantages of polychrome methylene blue in staining unfixed frozen tissue sections are that the finer details of the cell are obscured. A polychromatic stain giving colour reactions closely simulating those of hæmatoxylin and eosin has therefore been developed. The stain is prepared as follows:—To 4 parts of 1 p.c. aqueous azure A (azure I) which has been previously filtered there is added 1 part of filtered 0.5 p.c. aqueous Erie garnet B. The mixture is immediately filtered to prevent precipitation. Occasional refiltering may be necessary if the mixture has been standing a month or more. Sections cut with a freezing microtome are placed in the stain for from 10 to 15 seconds, then passed through two changes of distilled water on to a clean glass slide. A large drop of 40 p.c. glucose is placed on a clean cover-slip and immediately inverted over the section. The mounted specimen is then ready for examination provided $\frac{1}{2}$ to 1 minute has elapsed, before examining the section, in order to allow it to clear.
G. M. F.

A Gelatin Fixative for Paraffin Sections.—A. W. HAUPT (*Stain Technol.*, 1930, 5, 97-8). The gelatine fixative is prepared as follows:—Dissolve 1 gm. of gelatine in 100 c.cm. of distilled water at 30° C. Then add 2 gm. of phenol crystals and 15 c.cm. of pure glycerine. Stir well and filter. Only the best grade of gelatine should be used, and the temperature must not exceed 30° C. As in using albumin, the slide must be clean before mounting the ribbon upon it. Place a small drop of gelatine fixative on the slide and smear with the finger so that only a thin film is present. Flood with a 2 p.c. solution of formalin in distilled water. After mounting the ribbon on the slide, warm slightly on a copper plate to straighten it, then pour off the excess formalin solution and allow the slide to dry for at least 12 hours at room temperature, or place in an oven at 30° C.
G. M. F.

The Use of Buffers in Staining.—R. W. FRENCH. ("Practical Methods for the Control of Hydrogen-ion Concentration in Staining Procedures—the Use of 'Buffers,'" *Stain Technol.*, 1930, 5, 87-90). Data are given for the simple preparation of dry chemical mixtures to be used in the easy preparation of buffer solutions for use in the control of stain procedure. Two of these mixtures of special value in practical staining operations are the following:—4.539 gm. KH_2PO_4 , 5.940 gm. $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$ ($\text{pH} = 6.8$); 7.262 gm. KH_2PO_4 , 2.376 gm. $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$ ($\text{pH} = 7.4$). Hydrogen-ion control has been found to be essential to consistent results with the compound blood and tissue stains such as Wright's and Giemsa preparations. The more general use of a predetermined pH in staining is indicated.
G. M. F.

Vital Staining.—K. SATO ("On the Real Nature of Vital Staining," *Folia Anat. Jap.*, 1929, 8, 51-61). Vital staining is due to dye particles taken up in the cell body by a physical process. The density of the tissue elements and the diffusibility of the stain play a most important rôle in staining. Potassium compounds loosen, while calcium condenses tissue elements. When Indian ink is mixed with potassium compounds, larger and more numerous granules were taken up by phagocytes, while even the parenchyma cells of the liver were found to contain granules. When mixed with calcium compounds, Indian ink is not taken up by such cells as the liver parenchyma nor by the reticulo-endothelial cells of the splenic pulp.
G. M. F.

Safranin Differentiation.—HSU-CHUAN TUAN ("A New Method for Safranin Differentiation," *Stain Technol.*, 1930, 5, 103-7). A method is described for safranin differentiation in smears and paraffin sections. The technique for paraffin sections is as follows:—When darker staining is required, stain the slides in a saturated aqueous solution of safranin for 30 minutes to 3 hours. If the dye is slow in its action, treat the slides with dilute HCl before using. Rinse in water for a few seconds. Dehydrate in alcohols from 10 to 95 p.c., each containing 0.5 p.c. picric acid, allowing 5 to 10 seconds for each grade. If intermediate alcohol stages are desired, they may be introduced, and the time in each stage must then be reduced accordingly. Rinse in pure 95 p.c. alcohol with or without ammonia for 10 minutes. Clear in clove oil and counterstain if desired. Rinse in xylol for 15 minutes, mount in xylol-balsam. If a lighter stain is desired, allow only 1 minute in each grade of alcohol. Dehydrate in 100 p.c. alcohol for 1 minute; clear through mixtures of xylol and absolute alcohol; wash in xylol for 10 minutes, mount in xylol-balsam. G. M. F.

A Combined Peroxydase-Wright's Stain for Blood Films.—A. T. BRICE (*Stain Technol.*, 1930, 5, 101-2). For producing a combined peroxydase-Wright's stain, the following solutions are used:—Oxydase reagent: dissolve 0.3 gm. of benzedene base in 100 c.cm. of 95 p.c. ethyl alcohol. Add 1 p.c. of a saturated aqueous solution of sodium nitroprusside. This reagent should keep for 8 months to 1 year. Hydrogen peroxide: $\frac{1}{200}$ solution made by adding 2 to 3 drops to 15 c.cm. of distilled water. This must be freshly prepared immediately before use. Wright's stain, according to the usual formula: thin films are dried in air and are first flooded with the oxydase reagent, which is allowed to act for from 1 to 1½ minutes. An approximately equal portion of the hydrogen peroxide solution is then poured on the slide and allowed to act for 3 minutes. The slide is then washed thoroughly under the tap and dried by blotter and in air, and is next stained by Wright's method according to the usual technique. G. M. F.

The Analysis of Neutral Red and of the Pyronins.—W. C. HOLMES and A. R. PETERSON (*Stain Technol.*, 1930, 5, 91-6). Neutral red and the pyronins cannot be analysed chemically by the volumetric method of reduction with titanous chloride, while market supplies of neutral red, pyronin G and pyronin B contain nitrogenous dye intermediates which render other chemical methods of determining dye content unreliable. Data are furnished in the present paper which enable the analyst to obtain reliable dye-content values by means of a convenient spectrophotometric technique. G. M. F.

Localising Inorganic Substances in Microscopic Sections. The Micro-Incineration Method.—A. POLICARD and H. OKKELS (*Anat. Rec.*, 1930, 44, 349-61). In ordinary microscopic sections of any tissue the inorganic "skeleton" within the cells remains intangible; only a few qualitative tests from analytical chemistry can be transferred to the surroundings within the cell bodies; the inorganic matter, particularly heavy metals, are "masked," which means that they are probably present in the form of complex compounds. For the histologist the method of mineralising sections with strong mineral acids is worthless, because no structural remains are left, yet organic matter must be removed before microchemical tests can be applied. The following method has been devised to solve this problem. Mounted sections are heated in a red-hot tube furnace in such a manner as to burn all organic compounds. The entire mineral part of the tissue remains as ashes, arranged on the slide in the same position as it occurred in the

living cells, thus reproducing completely outlines and general features of the tissue. In this ash preparation any organ or tissue can be recognised. The method can be utilised in two ways: (1) to determine the distribution of inorganic matter as a whole throughout a given section; (2) as a preliminary process before localising definite mineral substances by means of specific reactions. In the ashes inorganic matter is now free, "unmasked," and lends itself to further microchemical tests both microcrystallographic and those based on colours. G. M. F.

Cross-sections of Hair.—G. F. FIALA ("Preparation of Hair for Cross-section Examination," *Am. J. Physical Anthropol.*, 1930, 14, 73-4). The method for the gross examination of cross-sections of hair is as follows:—Hollow out the top in the line of the grain of a small block of white pinewood, $1 \times 1 \times 0.5$ cm., so as to form a shallow groove. Cut a small notch at the middle of the edges of both sides of the groove. Turn over the block and fasten a strand of hair to the bottom with sealing-wax. Draw the hair around the block, guiding it through the notches so that it is stretched over the groove. Fasten the other end in the same manner. Moisten the hair above the groove with a drop composed of equal parts of absolute alcohol and ether. Apply thick celloidin to cover the hair. Harden for about 10 minutes and transfer to Gilson's mixture (equal parts of chloroform and cedar oil). Add cedar oil every $\frac{1}{2}$ hour until it composes 90 p.c. Remove and dry in the air for a few minutes. Cut through both hair and block with a sharp knife or razor. By standing half the block on its side on the condenser of the microscope, the cut ends of hairs can be seen by reflected light as dark ovals and circles against a light background. The block may be preserved in a dry stoppered bottle. G. M. F.

A Flagella and Capsule Stain for Bacteria.—H. D. BAILEY (*Proc. Soc. Exp. Biol. & Med.*, 1929, 27, 111-12). A small amount of material from a 15- to 24-hour agar growth is diluted through two successive drops of water on a slide, and a loopful of the second is smeared on a clean slide and dried without heat. The mordant (5 p.c. tannic acid 3 parts, 10 p.c. FeCl_3 1 part, filtered before use) is applied for 2 minutes. The following mixture is prepared: 7 drops of mordant, 1 drop of Ziehl-Neelson carbol fuchsin, and 1 drop of concentrated hydrochloric acid. One drop of formaldehyde is then added. After pouring off the mordant, the smear is covered with this mixture for 7 minutes and washed in running water. Ziehl-Neelson carbol fuchsin is added, and the slide is gently steamed for 30 seconds. The slide is again washed in running water. This method may be used for staining exudate from white mice killed with pneumococci as follows: Mix one loopful of exudate with one loopful of water and make a thin smear. Apply the mordant for 10 seconds; wash in water; apply cold diluted carbol fuchsin for 10 seconds; wash in water and blot. G. M. F.

Chloroform and Acid Stains.—F. CLAUSER and M. STRANI ("Primäre Färbung durch Chloroform und saure Farbstoffe," *Ztschr. f. Wis. Mikr.*, 1930, 47, 58-63). Chloroform facilitates nuclear staining of unfixed tissues with acid and electro-negative colloidal stains. The staining is almost immediate provided that only two substances (chloroform and the stain) are used. Intensity of the stain depends on its concentration, the time factor being of little importance. Three groups of stains were applied: (a) electro-negative colloidal stains (acid or anodical vital stains), trypan blue and carmine. Without the chloroform they give a faint nuclear stain after prolonged action, and fail to stain fatty tissue. (b) basic: thionin, gentian violet and bismarck brown. These stain also without chloroform, but the subsequent dehydration and xylol treatment are detrimental;

(c) acid : eosin, orange G, methyl blue. These fail to stain at all without chloroform. All the above stains were used in 1 p.c. aqueous solution, 3 c.cm. of which were mixed with 1 c.cm. of chloroform or ether. Rabbit's omentum stained for 5 minutes showed clear nuclei and presented pictures similar to sections treated in the usual way. The method may also be used on living animals, and has proved successful by injections in various organs. The chloroform staining method does not change the physico-chemical properties of the sections, which may be subsequently counterstained.

G. M. F.

The Silver Impregnation of Nerve Fibres.—H. A. DAVENPORT ("The Silver Impregnation of Nerve Fibers in Celloidin Sections," *Anat. Rec.*, 1929, **44**, 79–83). The following method proved successful for formalin-fixed brain tissues of the cat and man, though the results with the cerebral cortex were unsatisfactory. Celloidin sections are cut 15 to 30 μ thick and transferred to 80 p.c. alcohol; transferred for from 1 to 4 hours to a mixture of 85 c.cm. 95 p.c. alcohol with 15 c.cm. concentrated nitric acid, then washed in from three to four changes of 80 p.c. alcohol. The sections are allowed to stand at 37° to 40° C. preferably overnight in a silver nitrate bath (10 gm. dissolved in distilled water and added to 90 c.cm. of 95 p.c. alcohol). For gold toning impregnation lasts for from 18 to 24 hours. Sections are rinsed in absolute or at least in 95 p.c. alcohol, then developed for from 3 to 5 minutes in the following solution: 3 gm. pyrogalllic acid, 95 c.cm. 95 p.c. alcohol, 5 c.cm. neutral formalin (40 p.c.). If too dark, sections are placed for from 1 to 15 minutes in alcohol before developing, and are developed for from 1 to 2 minutes. If too light, alcohol is omitted and development takes 10 or more minutes. Clearing and toning may be carried out by (a) passing through 50 p.c. alcohol, fixing until chocolate brown, then 10 p.c. aqueous sodium thiosulphate; (b) two or three changes of 80 p.c. alcohol, 95 p.c. alcohol, xylol and Canada balsam; (c) gold toning by any of the standard procedures, in which case development must be longer. Impregnation must be carried out in the dark, but the rest of the handling may be done in diffuse light. The precipitate should be brushed off before mounting. Application of an alcoholic instead of an aqueous silver nitrate and of alcohol instead of water for rinsing improves the staining of the fibres. The pretreatment with alcoholic nitric acid inhibits the staining of glia and other connective tissue fibres, and thus assures a selective stain for fibres in celloidin sections.

G. M. F.

Single Cell Technique.—D. C. B. DUFF ("A Modification of the Orskov Single-Cell Technic," *J. Lab. & Clin. Med.*, 1929, **15**, 186–8). The original Orskov technique for isolating pure cultures of bacteria arising from single cells is essentially as follows:—A microscopic slide is scored with fine lines with a diamond pencil and is sterilised; a block of agar on which a dilute culture of the organism under investigation has been smeared is placed on the slide; a single cell is found by microscopic examination, its location on the mechanical stage noted, and a sketch made of the lines intersecting in its neighbourhood. The slide is incubated under proper moisture conditions for a few hours and is returned to the microscope; the original site is located, and the colony produced from the single cell is noted; the objective is then replaced by another on which a sterile needle has previously been mounted with wax; this needle is then lowered on to the colony, withdrawn, and the growth adhering to it washed off with a drop of sterile culture fluid. The writer modifies this technique by using Chamber's micro-manipulator so as to have the colony under observation at the moment of isolation. After locating the colony, a sterile pipette mounted in the micro-manipulator is lowered on to the

colony while it is under observation. The pipette is then withdrawn and the tip broken off into about 2 c.cm. of sterile medium.

G. M. F.

The Staining of Polar Bodies in Bacteria.—E. WEISS ("A Method for Staining of Polar Bodies," *J. Lab. & Clin. Med.*, 1929, **15**, 170-1). A modification of the Neisser method is described. The smears are fixed over a flame as usual and are then covered with the following solution:—Methylene blue Grüber 5 gm., 95 p.c. alcohol 10 c.cm., glacial acetic acid 5 c.cm., distilled water to 100 c.cm. The stain is then removed with running water and the slides covered for 1 to 2 minutes with 1 p.c. safranin or fuchsin 1 in 20. The slides are washed with water and dried. The metachromatic bodies are deep blue, the bacterial cells distinctly red.

G. M. F.

Blood Films Stained with Iron Hæmatoxylin and Giemsa's Stain.—C. W. REES ("Fixing Thin Blood Smears for Staining with Iron Hæmatoxylin and with Giemsa's Stain," *Science*, 1930, **71**, 134-5). Good preparations of blood smears with parasites (*Babesia bigemina*) stained with iron hæmatoxylin and Giemsa's stain may be obtained by the following method:—Thin smears are dried as for Giemsa's preparations and fixation completed with Schaudinn's alcoholic sublimate without acetic acid or following wet fixation by formaldehyde. The latter is accomplished by dropping the smear into 40 p.c. formalin and then treating with alcoholic sublimate as for dry smears. The method is especially advantageous when blood of anæmic cattle is used or when humidity retards drying.

G. M. F.

Permanent Staining with Aceto - Carmine.—J. C. H. DE MEYERE ("Über haltbare rasche Färbung vermittlest Azetokarmin," *Ztschr. f. Wiss. Mikr.*, 1929, **46**, 189-95). Permanent aceto-carmine preparations may be secured by the following method, which is suitable for the testes of other animals:—Dissect in physiological salt solution and fix in 50 p.c. acetic acid for 15 minutes. Dry with filter paper, transfer and tease on a slide smeared with albumin. Leave in absolute alcohol overnight. Cover the material with a few drops of aceto-carmine; iron alum or ferric hydroxide may be added to intensify the staining. When stained, flood and rinse in absolute alcohol. Mount in Venetian turpentine, as it tends to swell the cells and keep the chromosomes well apart.

G. M. F.

A Method of Staining Bacteria in Tissues by Gram's Method.—R. D. LILLIE ("The Gram Stain: a Quick Method for Staining Gram Positive Organisms in Tissues," *Arch. of Path. & Lab. Med.*, 1928, **5**, 828). Paraffin sections about 5μ in thickness or frozen sections fixed to the slide by the celloidin method of Mallory and Wright are brought down to water in the usual way. The sections are stained for 30 seconds with Hucker's ammonium oxalate crystal violet (1 minute for tubercle bacilli and leprosy bacilli); heat is applied, if necessary, to shorten the time of exposure. After washing in tap water, sections are flushed in Lugol's solution for 30 seconds, washed, and acetone applied drop by drop for 10 to 15 seconds; again washed and counterstained with 0.5 p.c. safranin for 30 seconds, washed in water, dehydrated, and differentiated with acetone, and cleared with xylol.

G. M. F.

A Differential Stain for Diphtheria Bacilli.—H. H. OWEN and M. BAND ("The Stoltenberg Differential Stain for Diphtheria Bacilli," *Am. J. Pub. Health*, 1930, **20**, 426-7). A comparison is made of the Stoltenberg diphtheria bacillus stain with the Loeffler alkaline methylene blue and the Albert stain. The Stolten-

berg technique is as follows:—Stain for 1 minute in the following mixture: malachite green 0.25 gm., toluidin blue 0.05 gm., hæmatoxylin 0.01 gm., distilled water 100 c.cm., acetic acid (strength not stated) 3 c.cm., ethyl alcohol (95 p.c.) 3 c.cm. Wash with tap water and dry. The granules appear red and the body green. Greater differentiation of the polar bodies is observed than with the Loeffler stain, but the Støttenberg technique is not so useful for differentiating *B. diphteria* from *B. xerosis* or other non-pathogenic forms with polar staining. G. M. F.

A New Carmine Method for Total Preparations.—J. E. LYNCH ("Eine neue Karminmethode für Totalpräparate," *Ztschr. f. Wiss. Mikr.*, 1930, **46**, 465–9). Borax carmine has been used for staining total preparations such as large protozoa, hydroids, bryozoa, trematodes, amphioxys and chick embryos. Specimens may be fixed in Zenker's, Schaudinn's, Gilson's or Bouin's fluid, in Da Fano's cobalt nitrate, acetic sublimate or preferably in formol; wash, if necessary, and pass up to 80 p.c. alcohol. Transfer to 50 p.c. or 35 p.c. alcohol, and then to alcoholic carmine of Grenacher (Grübler's "rubrum opticum" carmine is recommended) for from 2 hours to a day, till the specimens are well permeated. Add hydrochloric acid, shaking the vessel till a brick-coloured precipitate is formed. Stir well and leave overnight, avoiding excess acid. Pour off the stain and run up through slightly acidulated alcohols to 70 p.c. alcohol. Decolourise by adding 5 p.c. or more concentrated hydrochloric acid. Wash in several changes of 80 p.c. alcohol when differentiation is complete. Counterstain by adding Grübler's indulin (saturated in 80 p.c. alcohol) to the alcohol containing the material till it appears a light blue colour. Transfer to 95 p.c. alcohol when the borders of thin membranes and cilia become light blue. Care must be exercised not to overstain. Pass through the alcohols, xylol, and mount in balsam. Other possible counterstains are picric acid with indulin, light green, Lyons blue or indigo carmine. G. M. F.

Histology.

Leukæmia in Mice.—M. N. RICHTER and E. C. MACDOWELL ("Studies on Leukemia in Mice. I. The Experimental Transmission of Leukemia," *J. Exp. Med.*, 1930, **51**, 659–73). Lymphatic leukæmia has occurred with great frequency in a particular strain of mice which has been inbred by brother-sister matings since 1921. In addition to typical cases of leukæmia are others which, because of the absence of leukæmic changes in the blood, correspond to "pseudoleukæmia," and others which, by the presence of unusually great enlargement of certain lymph node groups, resemble the "leukosarcomatoses" as observed in man. Leukæmic blood pictures are not necessarily early in their appearance, nor are they constant. The blood picture may not, therefore, be used as a criterion for the separation of the two diseases (leukæmia and pseudoleukæmia), but merely indicates different phases of the same condition. Likewise, cases with lesions intermediate between the local growths of "leukosarcomatosis" and the more general lymphatic enlargements of leukæmia suggest that these conditions differ only in the distribution of lesions, but not in their nature. Lymphatic leukæmia occurring spontaneously in this strain cannot be transmitted to mice of other strains, but can be transmitted to mice of the same strain and carried, apparently, for an unlimited number of transfers in animals at an earlier age than that at which leukæmia occurs spontaneously. The lesions produced by inoculation correspond to those of spontaneous cases in that they consist of growths of abnormal lymphoid cells which infiltrate tissues and often appear in the circulating blood. Only minor differences have occurred, some of which are characteristic of certain experimental lines. After repeated transfers the disease tends to run a more acute course. G. M. F.

Experimental Typhus in the Rabbit.—S. TAKUBO and G. KAWAKUBO ("Experimental Studies on the Virus of Typhus Fever with the Rabbit. (Passage of the Virus through the Testicles of the Rabbit)," *Kitasato Arch. Exp. Med.*, 1930, 7, 186–200). Injection of the virus of typhus fever into the testicles of young rabbits produces specific macroscopical and microscopical changes, besides fever, loss of body weight, and diarrhoea. The virus that has passed through the testicle of the rabbit retains its virulence and immunological characteristics, as was proved by the inoculation of guinea-pigs and monkeys. The Weil-Felix test proved positive up from 1 in 80 to 1 in 320 with the blood of infected rabbits. G. M. F.

Embryology, Development, etc.

A Case of Intersexuality in *Bos indicus*, with a Theory of the Significance of the Genetic Male Intersex.—D. R. R. BURT (*Proc. Roy. Soc., Edin.*, 50, pt. ii, 113–29, 2 pls.). The external genitalia of the animal described were abnormal, being partly female and partly male in character. It possessed the internal sex equipment both of the cow and the bull to an almost equal extent, but with a slight balance in the male direction. On the right side there was a functional ovary, and on the other there was an infantile and abdominal testis. The ovary was associated with a perfectly-formed fallopian tube and uterine horn, while the testes, although small, were connected with an epididymis normal in size and structure. The uterine horn on the side of the testes ended blindly, and the ductus on the side of the ovary was incomplete. Following the uterus was a large vaginal chamber, in the floor of which ran the two ducti, and they all opened into the prostatic urethral chamber. The penis arose from this part and terminated in the normal position of the scrotum. This case of intersexuality is considered to be an animal primarily male in nature. It is suggested that the differentiation in the female direction is caused by the influence of the maternal sex hormones on the developing calf—that the usual barrier in the placenta, which protects the embryo from the sex hormone of the mother, has been overcome or broken down. It is thought that a direct communication between the blood vessels of the embryonic placenta and the maternal placenta would enable the maternal secretion to influence the developing calf. Such an hypothesis would account for the different degrees of development of the sexual apparatus in different cases of intersexes of this kind. It would reduce the two classes, the free-martin and the zygotic male intersex to the same order, being due to hormonal action in foetal life, the former due to male sex hormones elaborated in the testis of the co-twin and the latter due to female sex hormones elaborated in the maternal ovary. M. A.

The Action of Adrenalin on the Development of Amphibia.—F. E. LEHMANN ("Primitiventwicklung von Amphibien durch Adrenalin," *Revue Suisse de Biol.*, 1930, 37, 313–21). Developing eggs of *Rana fusca* and *Triton* were exposed during development to different periods in a medium containing adrenalin in a concentration of 1:1000. Gastrulation was abnormal even after an exposure of 6 to 8 hours, and after 24 hours all development ceased, but on returning to a normal medium the eggs continued to develop. By exposing embryos at different stages of development, the interesting fact was established that the varying stages of gastrulation show different degrees of sensitiveness to adrenalin, hence there must be changes taking place in the physico-chemical properties of the egg envelope. Only a small part of the differentiation mechanism was upset in all cases, and no lasting damage was done to the embryos, even after 24 hours' exposure. M. A.

Insecta.

Biological Races.—W. H. THORPE ("Biological Races in Insects and Allied Groups," *Biol. Rev. & Biol. Proc. of Cambridge Philos. Soc.*, 1930, 5, no. 3. 177–212). The occurrence of what have been variously called biological, physiological, or intraspecific races among insects has long been known. Recent work has, however, extended our knowledge of this subject to a great extent, and the close bearing that it has upon various problems of variation and evolution is becoming increasingly clear. A proper understanding of the subject is obviously of great importance to the economic zoologist, but it is hoped that this review will indicate that applied entomology has a contribution of real value to bring to the study of problems of more academic interest. A biological race may be said to exist where the individuals of a species can be divided into groups, usually isolated to some extent by food preferences, occurring in the same locality and showing definite differences in biology, but with corresponding structural differences, either few and inconstant, or completely absent. After giving a large number of interesting examples of the subject under consideration, the author concludes that many of these examples and experiments are easily explained on some form of Lamarckian theory, but extremely difficult to account for on any other lines. If the hypothesis were not such a debatable one, the evidence might well be regarded as almost conclusive. It seems equally certain, however, that none of the experiments recorded in these pages has been on a sufficiently extensive scale to carry complete conviction on the point. They do, however, suggest most profitable fields for further work of this nature, and, taken together, they provide a quite considerable amount of the constantly growing body of circumstantial evidence for the theory.

M. E. M.

Revision of Australian Oenochromidæ.—A. J. TURNER ("Revision of Australian *Oenochromidæ* (Lepidoptera), III," *Proc. Linn. Soc., New South Wales*, 1930, 55, no. 229, pt. 3, 191–220). The paper consists entirely of morphological descriptions of the particular species under revision, together with identification keys to the species.

M. E. M.

Family Tanyderidæ and a New Species.—C. P. ALEXANDER ("Observations on the Dipterous Family *Tanyderidæ*," *Proc. Linn. Soc., New South Wales*, 1930, 55, pt. 3, no. 229, 221–30, 1 text-fig., 2 pls.). In the present paper the author discusses two distinct subjects—(1) a preliminary description of the immature stages of the family *Tanyderidæ*, and (2) the description of a new species of *Radinoderus* from the Dorriggo Plateau of New South Wales. The recent discovery of immature stages of *Tanyderidæ* is a matter of great interest to students of the Order, since this was the sole remaining family of lower Orthorrhapha whose larva had baffled discovery up to the present time. Now that the larval habitat is known, and there is some idea of the general appearance of the larva, it is probable that the early stages of some of the larger and more showy of the Australian or New Zealand species will be discovered. After an account of the immature stages of the *Tanyderidæ*, the author discusses their affinity with the rest of the Orthorrhaphous diptera, and indicates the position of the larva of the *Tanyderidæ* by means of a table of morphological characters. The new species of *Radinoderus* was included in a large and interesting collection of crane-flies received from Mr. W. Heron, from Dorriggo Plateau, and the author's subsequent description refers to a female of this species under the name *Radinoderus dorrigensis* n. sp.

M. E. M.

Classification of the Australian Asilidæ.—G. H. HARDY ("Fifth Contribution towards a New Classification of Australian *Asilidæ* (Diptera)," *Proc. Linn. Soc., New South Wales*, 1930, **55**, pt. 3, no. 229, 249–60). In this and future parts of the author's studies in *Asilidæ* he is including notes on certain exotic forms that come within the tribes dealt with. For the specimens received he is indebted to the late Prof. M. Bezzi, and to Prof. J. Herve-Bazin for European genera, and to Prof. R. Painter and Mr. W. S. Bromley for the North American genera. New characters are being employed in these papers, and many of them are fairly well maintained in the various sections, but it must be understood that none of them is necessarily of generic or tribal importance; they are recorded only as they are found on the material before the author, and occasionally some misunderstanding of these characters may arise because they are found chiefly on preserved material. Closer investigation on fresh and supple material may show the possibility of other interpretations; therefore, as far as possible, all such characters must be examined on newly-killed material. Moreover, certain terms which have long been in use are now shown to be inapplicable, but more suitable names do not seem to have been substituted in such cases. One illustrative example is the so-called "meta-pleura," a bulging part just above the metathoracic spiracles. The hairs and bristles thereon seem to have some generic and subgeneric value, varying from an abundance of hairs to a row of bristles, or they may even be absent. Other parts of the pleura may also be clad with hair, but these parts have not been studied, and in the tribes here dealt with they are comparatively scarce. After a description of the characters of the prothorax and the chætotaxy, a table of the thoracic bristles is provided, and the classification of the tribe *Saropogonini* is set out by means of a key. A key to the subgenera of the *Stenopogon* is also given, and subsequently numerous genera and species are described, some of which are new to science.

M. E. M.

Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, XXIV," *Proc. Linn. Soc., New South Wales*, 1930, **55**, pt. 3, no. 229, 303–53, 44 text-figs.). Completes the notes on *Tuckinidæ*, of which the first section was published as No. XXIII of the series referred to in the title of this paper.

M. E. M.

The Collections from Alai-Pamir.—("Entomologische Ergebnisse der Deutsch-Russischen Alai-Pamir Expedition, 1928," *Mitteilungen aus dem Zoologischen Museum in Berlin*, 1930, **16**, pt. 2, 185–208, 1 map, 1 table, 17 text-figs.). This paper is the joint work of six collaborators. W. F. Reinig deals with the general description of the localities, the climate, the vegetation, and the scope of the expedition; W. Ramme with the species of *Dermaptera* and *Orthoptera*; H. Bischoff with the *Hymenoptera*, including the *Sphecidae*, *Vespidæ*, *Scoliidae*, *Mutillidae*, *Chrysidae*, *Ichneumonidae*, and the *Evaniidae*; H. Haupt with the *Hymenoptera* of the family *Psammocharidae*; H. Stitz with the *Hymenoptera* of the family *Formicidae*; and M. Bernhauer with the *Coleoptera* of the family *Staphylinidae*. Many of the genera and species dealt with are new to science.

M. E. M.

Biology of Associated Coleoptera.—G. R. STRUBLE ("The Biology of Certain Coleoptera associated with Bark-beetles in Western Yellow Pine," *Univ. Calif. Pub. Entom.*, 1930, **5**, no. 6, 105–34, 6 text-figs.). The study of forest entomology in America has been limited almost entirely to the insects more important economically, chief among which are the bark- and wood-borers. There is, however,

another field of investigations which has been much neglected—a study of the associated insect fauna. After bark- and wood-borers have successfully overcome the resistance of living trees, an environment is established which attracts numerous species of insects of secondary importance, represented chiefly by the Orders Coleoptera, Diptera, and Hymenoptera. The importance of many of these forms comes about through their effect on the primary insects, directly as predators and parasites, and indirectly as scavengers or phytophagous feeders, diverse rôles in which they affect the development of the primary insects. Of these, the Order Coleoptera is represented by the greatest number of species, and for this reason the writer has selected a few of the more important representatives of this Order for his study. The life-history and a description of the developmental stages of the following species are given:—*Platysoma punctigerum* Lec., *Plegaderus nitidus* Horn, *Hypophlaeus substriatus* Lec., and *Nudobius pubetanus* Csy. M. E. M.

Immature Forms of Curculionidæ.—R. E. BARRETT ("A Study of the Immature Forms of Some Curculionidæ (Coleoptera)," *Univ. Calif. Pub. Entom.*, 1930, 5, no. 5, 89–104, 28 text-figs.). Curculionid larvæ are often responsible for serious injuries to field and truck crops, but correct determination of exact species is often impossible unless the imago is also taken, and even this is not always conclusive. With the introduction and rapid spread of such weevils as the vegetable weevils, *Listroderes obliquus* Gyll., and the strawberry-root weevils, it is highly advisable for the entomologist to be able to determine the larvæ. An attempt has therefore been made in this paper to characterise the more commonly encountered and important Curculionid larvæ. Descriptions are given of the larvæ of the following species:—*Pantomorus godmani* Crotch., *Brachyrhinus sulcatus* Fab., *Brachyrhinus obatus* Linn., *Brachyrhinus rugosostriatus* Goeze, *Hypera punctator* Fab., and *Listroderes obliquus* Gyll. M. E. M.

A Hymenopterous Egg-Parasite.—L. M. SMITH ("Macrorileya oecanthi Ashm., a Hymenopterous Egg-Parasite of Tree-Crickets," *Univ. Calif. Pub. Entom.*, 1930, 5, no. 8, 165–72, 5 text-figs.). *Macrorileya oecanthi* Ashm. is an Eurytomid (*Chalcidoidea*) parasitic on the eggs of tree-crickets (genus *Oecanthus*). The present paper includes data on its life-history, habits, and economic significance, which were collected by the author while studying the life-history and control of the snowy tree-cricket, *Oecanthus niveus* De Geer. The observations were largely made at San José, California, during 1927, 1928 and 1929. The life-history of this parasite is made especially interesting by the facts that the eggs of the parasite are deposited by the side of the host eggs, and that the larvæ of the parasite tunnel along the canes in search of the eggs of *O. niveus*. A description of the male and female forms is included. M. E. M.

Reproductive System of the Codling Moth.—S. L. ALLMAN ("Studies of the Anatomy and Histology of the Reproductive System of the Female Codling Moth, *Carpocapsa pomonella* Linn.," *Univ. Calif. Pub. Entom.*, 1930, 5, no. 7, 135–64, 9 text-figs., 4 pls.). At the present time, as a result of the activities of *Carpocapsa pomonella*, approximately 40 entomologists are carrying out experimental work on this pest in various localities, dealing with control, spray-residues, bionomics, and mass-production of parasites. The adult insect is an inconspicuous moth which flies about the orchard at dusk, depositing its eggs on the leaves and fruits. The knowledge of this habit is of importance, both in respect to its control and to the functioning of the egg-laying females. Moths do not deposit eggs unless certain environmental factors are favourable for oviposition. Of these factors, temperature has received the most attention, and it is now conceded that little or

no deposition takes place unless the temperature at dusk is above 60° F.—in fact, certain control measures are timed on this basis. With these and other facts taken into consideration, the author has undertaken his study of the reproductive system, a full description of which is given. M. E. M.

Australian Coleoptera.—A. H. ELSTON ("Australian Coleoptera, Part VI," *Trans. & Proc. Roy. Soc., South Australia*, 1929, **53**, 347–52). In this paper the author describes new species of the two families *Elateridae* and *Cleridae*. Seven subfamilies are dealt with, of which 1 genus and 10 species are new to science.

M. E. M.

A New Marine Crane-fly.—M. TOKUNAGA ("The Morphological and Biological Studies on a New Marine Crane-fly, *Limonia (Dicranomyia) monostromia*, from Japan," *Mem. Coll. Agri., Kyoto Imp. Univ.*, 1930, no. 10, 1–93, 17 pls., 15 tables, and 5 diagrams). The author gives a very complete description of the material and methods used in this study, the morphological characters, taxonomic studies, and biological observations in connection with the new species of marine crane-fly *Limonia (Dicranomyia) monostromia*.

M. E. M.

Morphology of the Larva of *Dorcus parallelipedus* L.—E. E. EDWARDS ("On the Morphology of the Larva of *Dorcus parallelipedus* L. (Coleoptera)," *J. Linn. Soc., London*, 1930, **37** (Zool.), no. 251, 93 108, 7 text-figs.). The present paper is intended as a contribution towards a more complete understanding of the morphology of characteristic types of Coleopterous larvæ. The author's access to abundant living material of the larva of the Lucanid beetle *Dorcus parallelipedus* has afforded opportunity to make as complete a study as possible of its internal and external structure, which was carried out under the direction of A. D. Imms. Brief accounts of the external structure of the larvæ of *Dorcus* are to be found in the works of previous authors, but the most complete description is that of Schiodte (1873). Since the work of the latter authority is over 50 years old, it is naturally somewhat out of date with respect to modern conceptions of morphology, and it makes no reference to internal structure. The general internal and external features of the larva are here described in conformity with modern conceptions, together with certain conclusions which have been reached by the author.

M. E. M.

New Species of Australian Thrips.—D. MOULTON ("An Interesting New Thrips from Australia," *Trans. & Proc. Roy. Soc., South Australia*, 1929, **53**, 264–6, 1 pl.). Among a large collection of thrips sent from the South Australian Museum the author found a very unusual form which is unlike anything previously known. The greatly enlarged forelegs give it the general appearance of a crab, and it would seem, from the form of these legs, that the species must be predaceous. The genus and species are described in the present paper under the names *Carcinothrips leai* n. sp.

M. E. M.

New Australian Lepidoptera.—A. J. TURNER ("New Australian Lepidoptera," *Trans. & Proc. Roy. Soc., South Australia*, 1929, **53**, 297–308. This paper consists of a description of 26 new species.

M. E. M.

Chalcid Wasps from the South Australian Museum.—A. A. GIRAULT ("Notes on and Descriptions of Chalcid Wasps in the South Australian Museum," *Trans. & Proc. Roy. Soc., South Australia*, 1929, **53**, 309–46). The data and descriptions included in the present paper comprise a final report upon a collection of the Hymenopterous family *Chalcidae* loaned to the author by the Director of

the South Australian Museum. The types are in this museum, co-types in the Queensland Museum, Brisbane, but, as noted in the text, a few others have been distributed elsewhere. Descriptions are given of 84 new species. M. E. M.

Sense Organs of the Termite.—B. NOYES ("The Peripheral Sense Organs in the Termite *Termopsis angusticollis* Hagen," *Univ. Calif. Pub. Zool.*, 1930, **53**, no. 11, 259–86, 2 pls.). The behaviour of termites in the complex of social life within the colony, as well as their relations in establishing the colony in nature, suggest a well-developed peripheral nervous system. The present paper presents the results of a study of the distribution, general appearance, and relation to the nervous system of the peripheral sense organs of the Pacific Coast rotten-wood termite, *Termopsis angusticollis*. The author gives a description of the material and methods used in this study, and then proceeds to an account of the various sense organs, the sensory pores and hairs, and their physiology. M. E. M.

Life-History of the Beet Leaf-Hopper.—H. P. SEVERIN ("Life-History of Beet Leaf-hopper, *Eutettix tenellus* Baker, in California," *Univ. Calif. Pub. Entom.*, 1930, **5**, no. 4, 37–88, 16 text-figs., 3 pls.). The incubation periods varied from 11 to 55 days from February to October, the nymphal periods of the first brood from 23 to 37 days from April to October, and the egg and nymphal periods combined from 37 to 99 days. Eggs deposited from November 1 to January 15 failed to hatch, or the nymphs died out of doors. During the winter there was a high mortality of the nymphs which hatched from eggs deposited during September and October. The average egg-laying capacity of 5 females was 360 eggs. The eggs do not develop without fertilisation. Four broods were bred in cages from the dark females wintering in the cultivated areas of the San Joaquin Valley. After the flight of the pale green adults of the first generation from the plains and foot-hills in the cultivated areas, four more broods were also reared in cages. The months of maximum emergence of the first to fourth broods bred from the dark females were the same as those in which the second to the fifth broods were reared from the pale green leaf-hopper, as follows—June–July, July–August, September–October, October–November. Three generations of beet leaf-hoppers occur in the San Joaquin Valley. The progeny which develops from eggs deposited by the dark adults wintering on the plains and foot-hills represents the first or spring generation. The minimum preoviposition period of first brood adults was three days during July at a mean temperature of 80.3° F. M. E. M.

Abnormal Genitalia in *Bombyx mori* L.—Y. UNEYA ("On the Inheritance of the Abnormal Genitalia and its Environment in the Male Moth of *Bombyx mori* L.," *Proc. Imp. Acad., Tokyo*, 1930, **6**, no. 7, 285–8). The author has discovered a number of individuals having abnormal genitalia in male moths from the pure breed of Japanese bivoltine, and has already reported on the morphology of their copulatory organs, most of which have degenerated in the motor muscles of the penis. Such abnormal males have not only given the same breed year by year, but their appearance is considered as being very likely due to the action of environmental factors. The present study was begun as early as 1925, and conclusions have been reached to the effect that special environmental factors act upon the genes to produce such abnormality. The author describes, in this connection, his experiments on the effect of low temperature, high temperature, the stage affected by environment, and the effect of alteration of environment. M. E. M.

New Species of Eumolpid Beetles.—H. YUASA ("Two New Species of Eumolpid Beetles Noxious to the Mulberry Tree in the Liu-kiu Islands," *Proc. Imp.*

Acad., Tokyo, 1930, 6, no. 7, 293-5, 2 text-figs.). On examining a large number of Chrysomilid beetles from the Liu-kiu Islands in the collections of the Imperial Agricultural Experiment Station, and from other collections belonging to Mr. Yano, the author found two new species of Eumolpid beetles which are injurious to the mulberry tree in the adult stage. These are *Rhyparida sakisimensis* n. sp. and *Abirus yashiroi* n. sp., of which descriptions are given. M. E. M.

The "Scrub Itch Mite."—S. HIRST ("On the Larval Trombidiid Mite (*Trombicula hirsti* L. Sambon) that Causes the "Scrub Itch" of Northern Queensland and the Coorong, South Australia," *Trans. & Proc. Roy. Soc., South Australia, 1929, 53, 24-6, 1 text-fig.*). The larval Trombidiid mite known as the "Scrub Itch Mite," in Northern Queensland, was described by Louis Sambon under the name *Trombicula hirsti* in July, 1927. The original specimens were found on human beings at Innisfail, and the author has since re-examined them, as well as other examples from Tully. The same species of *Trombicula* attacks man in the south-eastern districts of South Australia, from Kingston to Robe, and also in the direction of Mount Gambier. During a recent visit to Robe the author was able to collect a large number of specimens of this mite. It is stated to be extremely abundant during the warmer months, especially in January. This larval form is found chiefly amongst the undergrowth beneath the tea trees. It has several local names, such as the "Robe Mite," "Tea Tree Mite," and "Red Spider." Persons walking in the tea tree scrub, or camping therein, are often badly bitten by this pest, and sometimes severe irritation, which may last for days, is caused by its bites. The author considers it probable that this mite, known variously as the "Scrub Itch Mite" of North Queensland and also "Tea Tree Itch Mite" of South Australia, is identical with the form described by Hatori under the name *Trombicula pseudo-akamushi*. The latter name has, however, also been used by Tanaka for another species. Further investigation of the Japanese literature is necessary before the correct name can be definitely settled. The species has a wide distribution, occurring in Japan, Sumatra, and the Malay Peninsula, besides Australia. So far, this mite is not known to convey disease, but allied forms, viz., *Trombicula akamushi* Brumpt and *T. deliensis* Halch, are known to transmit varieties of tropical typhus or pseudo-typhus. Another species, *Trombicula (Leeuwenhackeria) australiensis* Hirst, molests human beings in the Ashfield district of Sydney, New South Wales, and is also known to occur in Sumatra. Following this account of the habits and distribution of these mites the author gives a description of this species of larval *Trombicula*. M. E. M.

New Species of Coleoptera.—A. N. LEA ("Notes on Some Miscellaneous Coleoptera, with Descriptions of New Species, Part VII," *Trans. & Proc. Roy. Soc., South Australia, 1929, 53, 203-44, 5 text-figs.*). The author gives descriptions of 74 new species belonging to 15 separate families. M. E. M.

Platyhelminthes.

Trematoda.

The Life-History of Two North American Frog Lung Flukes.—WENDELL KRULL (*J. Parasitol., 1930, 16, 207-12, 12 figs.*). An account of the life-history of *Pneumonæces medioplexus* and *P. parviplexus* worked out experimentally in the laboratory, using *Rana pipiens* and *Rana clamitans* as respective definitive hosts. Dragon-fly nymphs acted as second intermediate hosts for both species of fluke. J. L.

On the Developmental Cycle of a Trematode of the Family Notocotylidæ Lühse (*Notocotylus attenuatus* Rud.).—PAUL MATHIAS ("Sur le cycle évolutif d'un Trématode de la famille des Notocotylidæ Lühse (*Notocotylus attenuatus* Rud.)," *Comptes-rendus Acad. Sci.*, 1930, 191, no. 1, 75-7). A description of the life-history of *Notocotylus attenuatus*. J. L.

Two New Trematodes from the Biliary Ducts of Birds from Armenia.—J. SKRJABIN and A. N. UDINZEV (*J. Parasitol.*, 1930, 16, 213-19, 1 pl.). Two new species of the family Dicrocoeliidæ, from the bile ducts of *Pica pica* and a mountain partridge, *Caccabis chukar*, are described, and a key given for the determination of all known species of the genera *Oswaldoia* Travassos, 1919, and *Lyperosomum* Looss, 1899. J. L.

Studies on the Trematode Family Strigeidæ (Holostomidæ). XXI. Life-Cycle and Description of the Cercaria of *Cotylurus michiganensis* (La Rue).—J. P. VAN HAITSMA (*J. Parasitol.*, 1930, 16, 224-30, 3 figs.). Tetra-cotyles (*T. communis* Hughes, 1928), found around the hearts of *Catostomus commersonii*, were fed to young herring gulls, and as a result large numbers of adult *Cotylurus michiganensis* (La Rue) developed in the bursæ Fabricii of the gulls. Eggs from these bursæ produced miracidia in less than 3 weeks. Of snails exposed to the miracidia, only two specimens of *L. emarginata angulata* became infected, and produced cercaria in about 40 days. The peculiar structure of the cercaria is described in detail. J. L.

An Experimental Study of the Behaviour of *Cercaria floridensis* in Relation to its Fish Intermediate Host.—H. M. MILLER and O. R. MCCOY (*J. Parasitol.*, 1930, 16, 185-97, 2 figs.). The authors have made a study of the chemotactic reactions, the penetration, the longevity and infectivity of *Cercaria floridensis* McCoy (1929) under experimental conditions. They found that there was no "chemical" attraction to the fish intermediate host or by the tissue fluids of the fish, but that an entangling factor seemed to be the important one in penetration behaviour. Infectivity decreased rapidly after 12 hours at an approximate rate of 13 p.c. per hour, but infection was possible up to 36 hours. The pectoral and caudal fins were most heavily parasitised. While fish in the lower levels of aquaria were more heavily infested when exposed to cercaria in the dark, the reverse was true for fish confined near the surface. The swimming upward of cercariæ was in response to shadow stimuli. J. L.

Cestoda.

Notes on the Hatching of *Diphyllbothrium latum* Eggs.—LYELL J. THOMAS (*J. Parasitol.*, 1930, 16, 244-5, 1 fig.). Most of the eggs (which were kept in covered dishes at room temperature and out of the direct rays of the sun) hatched viable coracidia within 12 days. The remaining eggs hatched occasionally over a period of about 2 months, and these later hatching individuals were smaller in diameter than those normally hatched. The variability in the time required for hatching might be an adaptation to ensure possible infection of copepods for some time after the regular hatching period was over. It might also be one explanation of the variability in size of the procercooids encountered in experimentally infected copepods. J. L.

A New Anoplocephalid Cestode.—JOHN R. DARRAH ("A New Anoplocephalid Cestode from the Woodchuck, *Marmota flaviventris*," *Trans. Amer. Mic.*

Soc., 1930, 49, 252-7, 1 pl.). A description of *Diandrya composita* n. gen., n. sp. It differs from the genus *Andrya* in having a double set of reproductive organs.
J. L.

Nemathelminthes.

Nematoda.

Parasitism and Fistulous Withers.—JAMES E. ACKERT and W. S. O'NEAL (*J. Amer. Vet. Med. Assoc.*, 1930, 77, N.S. 30, 28-36, 1 pl.). Portions of *Onchocerca cervicalis* or of the calcified worms were recovered in ten out of twelve examinations of the ligamentum nuchæ of horses. The parasite is described, and the following new diagnostic characters for the species are added: four very small oral papillæ, three very prominent terminal papillæ on the tail of the female, the location of the nerve ring.
J. L.

Specific Characters in the Genus *Trichuris*, with a Description of a New Species, *Trichuris tenuis*, from a Camel.—ASA C. CHANDLER (*J. Parasitol.*, 1930, 16, 198-206, 2 pls.). The unsatisfactory nature of the existing specific characters of *Trichuris* is pointed out. Six species are here described, including *T. tenuis*, a new species from a camel, and certain additional characters given concerning the male genitalia and the intestine, which characters are, in the author's opinion, highly reliable and easily determinable.
J. L.

The Biology of Hookworms in their Hosts.—J. ALLEN SCOTT (*Quart. Rev. Biol.*, 1930, 5, 79-97). The author's main purpose has been to summarise certain experimental studies on the biology of the species of hookworms parasitic in dogs and cats, more especially dealing with the parasitic stages. The work has been grouped under the following headings: specificity, entrance into the host, migration to the seat of infestation, growth, reproduction, effect on the host, biological variations in hookworms correlated with variations in the host, and immunity and its mechanism, and the paper concludes with a discussion of the present problems in the biology of hookworms.
J. L.

Revision of the Nematode Genus *Torquatella*, with a Description of *Torquatella crotophaga* sp. nov.—OWEN L. WILLIAMS (*Univ. Calif. Pub. Zool.*, 1929, 33, 169-78, 7 figs.). The genus *Torquatella* Yorke and Maplestone, 1926, is redefined and emended to include forms with eight head papillæ, those with more or less than three post-cloacal papillæ, and those lacking the gubernaculum. Two subgenera are made, *Torquatella* and *Torquatoides*, on the basis of presence or absence of lateral alæ and the possession of four or eight head papillæ. The new species of *Torquatella* described was recovered from under the lining of the gizzard of *Crotophaga ani* L. in the Panama Canal zone.
J. L.

On a New Genus of the Nematode Family Acuariidæ seurat, 1913.—N. SHIKHOBALOVA (*J. Parasitol.*, 1930, 16, 220-3, 1 pl.). A description of *Skryabinocerca prima* n. gen. n. sp., obtained from the œsophagus of *Trypanocorax pastinator*, from the Isle of Sakhalin.
J. L.

The Effect of Age and Size of Infestation on the Egg Production of the Dog Hookworm, *Ancylostoma caninum*.—MERRITT P. SARLES (*Amer. Journ. Hyg.*, 1929, 10, 658-66). By means of the small drop egg-counting method of Stoll and Hausheer, counts were made of the eggs passed in the stools of dogs during two periods of three consecutive days. After the second counts the dogs were autopsied and the adult worms recovered. It was found that the egg production was much less in large than in small infestations, and this could not be

correlated with variations in the size of the worms. The egg production of the worms increased definitely only during the first month of the infestation, and was greater in small infestations than in large ones. J. L.

Host-induced Variation in the Growth Curve of the Dog Hookworm, *Ancylostoma caninum*.—J. ALLEN SCOTT (*Amer. Journ. Hyg.*, 1929, 10, 125-39, 4 figs.). Dogs and cats of all ages were infected with larvæ given in gelatin capsules *per os* in doses which produced infestations not exceeding a thousand worms. It was found that neither the size of the infestation nor the age of the animal produced measurable variations in the results. The final moult occurred in approximately 6 days in dogs and in 11 days in cats. The worms were thus taken to be adult in 7 and 12 days respectively, and the measurements were made during this final stage from silhouette photographs of the worms. The growth curve of the adult parasites appeared to resemble that of other types of organisms, and observations on the length of specimens of various ages were fitted reasonably well by a logistic curve. The final size of these specimens from experimental infestations agreed closely with the average size of specimens from natural infestations. There was a high host-induced variation. Results also showed that the ability to grow at all in a given host was inherent in the worms, but that the growth rate and final size were controlled by the host. Sexual maturity was correspondingly delayed in a host which induced relatively slow growth. J. L.

The Influence of Temperature, Hydrogen-ion Concentration, and Oxygen Tension on the Development of the Eggs and Larvæ of the Dog Hookworm, *Ancylostoma caninum*.—O. R. MCCOX (*Amer. Journ. Hyg.*, 1930, 11, 413-48, 4 figs.). 37° C. and 15° C. were the highest and lowest temperatures at which larvæ of *Ancylostoma caninum* reached the infective stage in agar cultures with bacteria as food. Judging, however, by the percentage of infective larvæ produced and the final size they attained, 23° C. and 30° C. were the most favourable temperatures. The latter could be taken as optimum. Hydrogen-ion concentration in itself was probably of little significance in the development of hookworm eggs and larvæ. Larvæ became infective in suspensions of bacteria in buffer solutions ranging from pH 4.0 to pH 10.0, but at the extremes a smaller percentage of larvæ matured. The range of pH for the hatching of eggs was very similar. It was found that the eggs hatched normally in water containing only one-fifteenth of the amount of oxygen ordinarily dissolved in water at room temperature, but that oxygen tensions lower than 0.4 cc. per litre greatly retarded development. Newly-hatched larvæ survived for at least five days under conditions of very low oxygen tension. Oxygen pressures proved very harmful to the eggs, a tension of 30 cc. per litre completely inhibiting normal development. The oxygen consumption of infective larvæ at different temperature was found to increase about 9 p.c. to each rise of 1° C. J. L.

Acanthocephala.

An Acanthocephalan, *Corynosoma strumosum* (Rudolphi), from the Californian Harbour Seal.—GORDON H. BALL (*Univ. Calif. Pub. Zool.*, 1930, 33, 301-5, 8 figs.). Very large numbers of the worms *Corynosoma strumosum* Rud., including some mature specimens, were found in the small intestine of a three-weeks-old seal which was killed off the coast of Point Mugu, Ventura County, California. They appeared to be definitely pathogenic to the host, which was obviously weak and ill when captured. This is believed to be the first recorded occurrence of infection of any of the seals of the Pacific coast by an Acanthocephalan. The parasite is briefly described. J. L.

Protozoa.

Cultivation of *Endamœba coli*.—M. TANABE, N. KUWABARA, and E. CHIBA ("On the Cultivation of *Endamœba coli* in Tanabe and Chiba's Medium," *Keijo J. Med., Japan*, 1930, 1, 21-3). A description of the cultivation of *Endamœba coli* in Tanabe and Chiba's medium. The medium is as follows:—Agar slants are made with 1,000 cc. Ringer's solution, 10 gm. agar and 1 gm. asparagin. These slants are covered to the height of the agar with Ringer's solution, to which 5 p.c. rabbit serum is added (or a mixture of 8 parts Ringer's solution and 1 part horse serum). Before inoculation two or three loopfuls of rice starch, sterilised at 160-180° C. (dry heat) for about 1 hour, are added to the fluid part of the medium. "In this medium the amœbæ grow luxuriantly," as long as twelve days without sub-cultivation. One strain was carried through 170 generations in the course of 339 days, and another one for 168 in 334 days. The amœbæ are said to encyst and excyst readily in this medium. C. A. H.

Pathogenicity of Cultivated Dysenteric Amœbæ.—E. CHIBA and N. KUWABARA ("On the Pathogenicity of *Endamœba histolytica* cultivated in Tanabe and Chiba's Medium," *Keijo J. Med., Japan*, 1930, 1, 24-8). The experiments described were conducted with the view of testing the disputed question as to whether *Endamœba histolytica* cultivated in a medium containing starch is capable of producing dysenteric symptoms in kittens. Six strains of amœbæ originating from acute dysenteric stools, a liver abscess, and stools of "carriers," were grown in Tanabe and Chiba's medium for periods from 15 to 202 days. The cultures were then inoculated into kittens. It was found that all these strains were pathogenic to kittens, producing in them typical dysentery. It is concluded that the ingestion of rice by *E. histolytica* does not result in loss of pathogenicity. C. A. H.

Endomixis in *Balantidium*.—A. M. DA CUNHA and J. MUNIZ ("On the Endomixis Phenomenon in Ciliata of the genus *Balantidium*. Observations concerning the Encystment of these Ciliata, and Description of a New Parasitic Species of *Macacus rhesus*," *Mem. Inst. O. Cruz.*, 1930, 23, 189-235, 17 pls.). A description is given of a new form of *Balantidium* from the cæcum and colon of *Macacus rhesus*, named *B. simile* sp. n. The active forms of this ciliate are indistinguishable from *B. coli*, but their cysts differ, those of *B. simile* measuring from 23 to 38 μ in diameter and possessing two macronuclei, while in *B. coli* the cysts measure from 38 to 43 μ and have a single nucleus. The description of endomixis in *B. simile* is the first record of such a process in parasitic ciliates. The phenomenon is said to differ from that in other ciliates in a number of preliminary divisions, called "progamic," which give rise to special forms, "pre-conjugants." Another point of difference is the transformation of all nuclei resulting from the division of the micronucleus into so-called "placentæ," one of which later gives rise to a new micronucleus. The "placenta" is produced by enlargement of the micronucleus, and consists of a linin-reticulum, over the fibres of which the chromatin is distributed in the form of minute granules. C. A. H.

A New Silver-Impregnation Method for Ciliates.—E. CHATTON and A. LWORFF ("Imprégnation, par diffusion argentique, de l'infaciliature des ciliés marins et d'eau douce, après fixation cytologique et sans dessiccation," *C. R. Soc. Biol.*, 1930, 104, 834-6). Description of an improved silver-impregnation method for demonstrating the ciliary apparatus of infusoria. The technique is as follows:—(1) A drop of fluid containing the ciliates is placed on a clean slide; any excess of water is pipetted off. (2) Fixation with Da Fano's mixture: cobalt nitrate 1 gm.,

non-neutralised formol 10 c.c., water 90 c.c. (in the case of marine ciliates sea-water is used, in the case of freshwater forms distilled water with the addition of NaCl 1gm.). Two or three large drops of the fixative are added to the drop of water containing the ciliates, and the slide is shaken to mix the fluids. After fixing for 10 minutes the excess of fluid is removed. (3) Embedding in saline gelatine (gelatine 10 gm., NaCl 0.05 gm., Aq. dest. 100 cc.) melted at 25° C. One drop of this gelatine is placed on the slide, spread in a thin layer and allowed to solidify, without desiccation, 1 to 2 minutes. (4) A 3 p.c. solution of silver nitrate in distilled water is poured over the gelatine and allowed to act for 5 minutes. The slide is then rinsed in distilled water for a few seconds to remove excess of nitrate. (5) The preparation is exposed to light in a white porcelain dish under a layer of distilled water for 5 to 20 minutes (according to the source of light). (6) The slide is dehydrated and mounted in balsam. This method—which is said to be superior to that of Klein—allows to demonstrate the finest details of the ciliary system and at the same time preserves the form of the body of the ciliate. C. A. H.

Division and Conjugation in Euplotes.—J. P. TURNER ("Division and Conjugation in *Euplotes patella* Ehrenberg, with Special Reference to the Nuclear Phenomena," *Univ. Calif. Pub. Zool.*, 1930, **33**, 193–258, 12 pls.). *Euplotes patella*, the division and conjugation of which were studied, was cultivated in a medium composed as follows:—5 gms. timothy hay, 10 halves of split peas, and 10 grains of wheat added to 1 litre of water, boiled and set aside for a day. The medium is later inoculated with *Chilomonas*, which serves as food for the ciliate. Various fixatives and stains were used for preparation. During division the old peristome remains unchanged. All cirri and neuromotor fibrils are replaced at division by new ones. During division of the macronucleus a double "reorganisation band" passes from each end to the middle, where the two unite and disappear before fission. Division of the micronucleus is accompanied by the appearance and division of eight chromosomes. An endosome is seen in early and late stages. Conjugating individuals are joined by their left peristomal margins. During conjugation all motor organelles are replaced by new ones. The micronucleus undergoes a preliminary division and two maturation divisions, giving rise to eight nuclei. Six of these degenerate and two divide again, forming two pronuclei and two degenerating nuclei. During the first maturation division 32 chromomeres are produced, 16 passing to each pole. Reduction occurs in the second maturation division: 8 chromosomes appear on the spindle, unite in pairs and later separate, 4 passing to each pole. The pronuclei have 4 chromosomes. On separation of the conjugants the amphinucleus divides twice, producing 8 chromosomes each time. Of the 4 resulting nuclei, 1 becomes the new micronucleus, 2 degenerate, and 1 is the new macronuclear anlage. The latter fuses with the reconstituted portion of the old macronucleus to form the new macronucleus. C. A. H.

Intestinal Ciliate from Sea-Urchins.—J. E. LYNCH ("Studies on the Ciliates from the Intestine of *Strongylocentrotus*. II. *Lechriopyla mystax*, gen. nov., sp. nov.," *Univ. Calif. Pub. Zool.*, 1930, **33**, 307–50, 3 pls., 2 text-figs.). *Lechriopyla mystax*, gen. n., sp. n., occurs in the intestine of the sea-urchins, *Strongylocentrotus franciscanus* and *S. purpuratus*, from Pacific Grove, California. It belongs to the family Plagiopylidae (Trichostomata Holotrichida), and is characterised as follows: reniform, 113–174 μ long; transverse peristome in anterior half of the body, lined with short modified cilia; pharynx ciliated; band of transverse pellicular striations starting near peristome, running anteriorly, then circling dorsally, to run posteriorly about two-thirds the length of the body; macronucleus and micronucleus single;

contractile vacuole terminal; trichocysts present. Differs from *Plagiopyla* in the presence of an internal organelle, the furcula, embracing the vestibule, and a motorium at the left end of the peristome. Both these organs are apparently elements of the neuromotor system. The ciliate contains two types of cytoplasmic inclusions—minute granules staining with neutral red and brought out by osmic acid following fixation designed for Golgi elements, and mitochondria of peculiar structure, “consisting of a disc of chromophobe substance bearing a tire-like rim of chromophile material.” The mitochondria are arranged in groups. C. A. H.

Morphology and Division of Babesia.—E. W. DENNIS (“The Morphology and Binary Fission of *Babesia bigemina* of Texas Cattle Fever,” *Univ. Calif. Pub. Zool.*, 1930, **33**, 179–92, 2 pls.). Previous knowledge of the structure of *Babesia bigemina*, the ætiological agent of Texas fever, was based mainly on dry smears stained by the Romanowsky method. In the present work “wet” fixation with Schaudinn’s fluid (without acetic acid) and staining with Heidenhain’s iron alum-hæmatoxylin was relied upon. The nucleus of this piroplasm is vesicular with an eccentric karyosome. Arising from the nucleus is a siderophile rhizoplast that extends toward the pointed end of the body and terminates in a blepharoplast. Division proceeds by binary fission of the extranuclear apparatus and nucleus accompanied by fission of the cytoplasm. In the later stages of Texas fever the parasites progressively diminish in size by a process of autotomy. The author believes that in its organelles and mode of division *B. bigemina* is morphologically related to the flagellates rather than to the sporozoa. C. A. H.

A Revision of the Tintinnoinea.—C. A. KOFOID and A. S. CAMPBELL (“A Conspectus of the Marine and Freshwater Ciliata belonging to the Suborder Tintinnoinea, with Descriptions of New Species, principally from the Agassiz Expedition to the Eastern Tropical Pacific, 1904–1905,” *Univ. Calif. Pub. Zool.*, 1929, **34**, 1 403, 697 text-figs.). In this work the authors have given a monographic description of the ciliate suborder Tintinnoinea based on the material collected by the Agassiz Expedition, 1904–05, at 127 stations in the eastern tropical Pacific, by other bodies off the coasts of California and Alaska, and *en route* from Washington to Ceylon. This systematic analysis of the entire group includes a critical examination and revision of earlier descriptions of these ciliates. All the species which, in the judgment of the authors, are valid are dealt with, with their synonymy, bibliographic citations of the original description and figures, and the *nomina nuda*. Altogether 276 new species are diagnosed, and 38 others are given new names. Types have been designated for all of the 51 genera, including 23 new genera. There is a figure to illustrate practically every species described in the text. The diagnosis of these ciliates was based exclusively upon the morphological features of the lorica, which, according to the authors, “as clearly reveals specific characters and as distinctly exhibits generic affiliations as does the exoskeleton of the Dinoflagellata or the internal skeleton of the Radiolaria. It affords a reliable index of relationship and a sound basis of classification.” Size was not relied upon, since it appears to be correlated with temperature and to be subject to variation. There are a bibliographical and a systematic (alphabetical) index.

C. A. H.

Structure of Chlamydomonas.—J. MCA. KATER (“Morphology and Division of *Chlamydomonas*, with Reference to the Phylogeny of the Flagellate Neuromotor System,” *Univ. Calif. Pub. Zool.*, 1929, **33**, 125–68, 6 pls., 7 text-figs.). A description of *Chlamydomonas nasuta* is given. Its shape is oval or pyriform, size from 9×12 to $15 \times 20\mu$. The pyrenoid is posterior to the nucleus and does

not form part of the chloroplast. During mitosis it disappears and is reformed by modification of the cytoplasmic alveoli. The nucleus is said to be of the metazoan and metaphyten type, with a reticulum and nucleolus characteristic of higher organisms. The nucleal reaction shows that the nucleolus is composed of a cortex of granular chromatin bodies and an achromatin substratum. Eight chromosomes are formed by condensation of the chromatin of the nucleolus and reticulum. The nuclear membrane remains intact until the late telophase; after its disintegration the division figure becomes metazoan in type. The neuromotor system consists of two flagella and blepharoplasts, a rhizoplast, and an intranuclear centrosome. The latter gives rise to the intradesmose at the beginning of division, and initiates the formation of the spindle. In the immotile division stage the cell undergoes one to three divisions, between which a period of growth intervenes. The entire neuromotor system, with the exception of the centrosome, disappears and is regenerated from the centrosome. After a comparison of the neuromotor apparatus in various groups of flagellates, it is concluded that it has a nuclear origin.

C. A. H.

Life-History of a Rotalia.—J. HOFKER ("Der Generationswechsel von *Rotalia beccarii* var. *flevensis*, nov. var.," *Zeitschr. für Zellforschung und micros. Anatomie*, 1930, 2, 4, 756-68, 1 text-fig.). The variety, which is from brackish water in the Zuyder Zee, exhibits typical trimorphism (Forms A1, A2, B). This trimorphism is the expression of an alternation of generations which keeps pace with the seasons. The B form is the winter resting stage, and in spring forms plasmodiospores asexually, which grow up into the A1 form. The A1 form in summer develops into the A2 form, distinguishable by the presence of a chromidium. In this form microspores are developed by mitotic subdivision, and the copulation of these microspores results in the production of the microspheric B form in the autumn.

A. E.

Recent Californian Foraminifera.—J. A. CUSHMAN and DOROTHY A. MOYER ("Some Recent Foraminifera from off San Pedro, California," *Cont. Cushman Lab. Foram. Research*, 1930, 6, no. 93, 49-62, 2 pls.). Most of the species and varieties found in the Pliocene deposits of California are now living off that coast, and a study of their ecologic conditions can therefore be used for an interpretation of the Pliocene deposits. A list of 68 species and varieties found off San Pedro in depths ranging between 12 and 400 fathoms is given, including two new varieties. The majority of the forms come from a depth of 35-50 fathoms. There is no record of frequencies. The paper includes a list of publications dealing with Californian recent and fossil foraminifera, in which most of the species recorded are adequately figured and fuller synonymies given, and the illustrations to the present paper are mainly confined to species which have not been previously figured or which are considered to be of special interest. The plates are good.

A. E.

Another d'Orbigny Type Studied.—J. A. CUSHMAN ("On *Uvigerina pigmea* d'Orbigny," *Cont. Cushman Lab. Foram. Research*, 1930, no. 94, 62-3, 7 figs. on pl. 9). Continuing his studies of earlier types, Cushman now deals with a species which was established by d'Orbigny in 1826 on the strength of a model, No. 67, two figures, and a reference to figures in Soldani. The locality is given as fossil in the neighbourhood of Siena, and Pliocene clay collected by the author in 1927, at Coroncina, near Siena, yielded abundant specimens which agree with d'Orbigny's figures in the possession of numerous sharp longitudinal costæ. The final chambers are nearly smooth, but furnished with numerous short spines which

could not be reproduced in the plaster model. Subsequently, in 1846, d'Orbigny referred specimens from the Miocene of Vienna to his earlier species, but they do not appear to be identical. The figures in the *Challenger* Report referred by Brady to d'Orbigny's species have been accepted by many later authors as typical, but Cushman regards them as belonging to two distinct species. Figures are given of topotype specimens, with copies of d'Orbigny's original drawings and a sketch of his model. A. E.

Cretaceous Foraminifera from Venezuela.—J. A. CUSHMAN and H. D. HEDBERG ("Notes on Some Foraminifera from Venezuela and Colombia," *Cont. Cushman Lab. Foram. Research*, 1930, no. 95, 64–9, 1 pl.). Very little is known of the fossil foraminifera of South America. The Cretaceous of Venezuela and Colombia is similar in its general characters and in many of its species to the Cretaceous of Europe and of the coastal plain region of the United States. Eight species, five of which are new, are described and figured, the most interesting being *Elphidium subsphaericum*, a new species closely related to the type *E. striatopunctatum* from the Red Sea, but characterised by its smaller size, fewer chambers, and even more inflated shape. It appears to be confined to a zone only a few hundred feet thick, while other species of *Elphidium* are fairly common through the whole formation, which is several thousand feet in thickness. A. E.

Upper Eocene Limestones in South Africa.—F. CHAPMAN ("On a Foraminiferal Limestone of Upper Eocene Age from the Alexandria Formation, South Africa," *Ann. S. African Mus.*, 1930, 28, pt. 2, 291–6, pl. xxxvii). The rock shows abundant well-preserved tests of *Discocyclina pratti* and *D. varians*, together with other smaller foraminifera scattered through a matrix of calcitic grains, often finely granulated or full of inclusions. Glauconite grains form a small proportion of the ground mass, and the chambers of the *Discocyclinae* are frequently infiltrated with the same mineral. The organic remains form about 50 p.c. of the mass, and include Polyzoa, Pelecypoda, echinoid plates and spines, etc. The material was studied by means of thin sections, with the result that specific identity could not be ascertained in many instances. Photographs of two sections containing *D. pratti* in different planes are given. A. E.

Fossil Foraminifera from Florida.—J. A. CUSHMAN ("The Foraminifera of the Choctawhatchee Formation of Florida," *Florida State Geol. Survey*, 1930, bull. 4, 1–92, 12 plates). The formation has numerous foraminifera and in some parts a rich fauna. Three faunal zones are recognised, of which the lowest carries a very characteristic foraminiferal fauna. The middle and upper zones are characterised by numerous species not found in the lowest zone, but there are few species not common to the two. The two lower zones are characterised by cool water species, while the upper zone carries a somewhat warmer water fauna, including *Amphistegina lessonii* d'Orb., a species now living in warm shallow waters. The relationships of the fauna are interesting. Many of the species are not known elsewhere, or at least only in the Miocene of the United States coastal plain. Others seem identical with specimens from the Miocene of Panama and the West Indies, while yet others are identical or closely allied to the species of the Miocene and Pliocene of California. Of the species still living, those of the upper zone are represented in the waters of the West Indies. Other species are now known only from the western coast of South America or extending up the southern coast of North America, having apparently died out in the Miocene in the Western Atlantic and persisted in the Pacific. There are 13 new species and varieties, and the paper is very fully and admirably illustrated. A. E.

Endothyra as a Devonian Fossil.—D. LE MAITRE ("Sur la présence d'algues et de foraminifères du genre *Endothyra* dans des calcaires d'âge dévonien," *Comptes-rendus de l'Acad. Sci.*, 1930, no. 12, 763-5). At least two different species of *Endothyra* were found to be common in thin sections of a Devonian limestone from Bartine in Asia Minor. The limestone came from an important series of Devonian age which rest on limestones and quartzites of "coblencien" age and are themselves overlaid by other Devonian limestones and then by the Carboniferous. Its age, judging by its other fossils, stromatopores and corals, is middle Devonian. This discovery takes back the geological history of *Endothyra* considerably, the genus having been previously known only from strata ranging between the Carboniferous and the Trias. A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Chromosome Number and Morphology in *Nicotiana*.—PRISCILLA AVERY ("Chromosome Number and Morphology in *Nicotiana*. IV. The Nature and Effects of Chromosomal Irregularities in *N. alata* var. *grandiflora*," *Univ. Calif. Pub. Bot.*, 1929, **11**, 265-84). The somatic chromosome number in *N. alata* is 18. The nine pairs of somatic chromosomes can be placed in five morphological groups according to differences in size, the position of constrictions, and the presence of satellites. Plants derived from a monosomic plant have been examined cytologically. Of 57 plants from the cross normal ♀ × monosomic ♂, only two showed chromosome numbers other than 18, both having 19 somatic chromosomes. Of 22 plants from the cross monosomic ♀ × normal ♂, 4 showed varying chromosome numbers—22, 25, 26 and 27. One normal diploid plant had three tetraploid roots. The plants with 22 and 25 chromosomes alone showed marked distinction from normal in external morphology. Pistillody of the stamens occurred in a 3 : 1 ratio in the progenies studied. Non-conjunction of one or two pairs of chromosomes often occurred in trisomic plants, giving 8-11 divisions in homotypic anaphase instead of 9-10. Dyads with 19 chromosomes formed 12 p.c. of the pollen mother-cells of one trisomic plant. It is suggested that non-conjunction, non-disjunction, and diploid gametes are responsible for the deviating chromosome numbers found.

J. L.

Chromosome Number and Morphology in *Nicotiana*.—LILLIAN HOLLINGSHEAD ("Chromosome Number and Morphology in *Nicotiana*. III. The Somatic Chromosomes of *N. longiflora* Cav.," *tom. cit.*, 257-64). The somatic chromosome complex of *Nicotiana longiflora* consists of 20 units of somewhat different lengths. The two shortest pairs generally bear distal heads separated from the shaft of the chromosome by constrictions. There is evidence that spindle fibre attachment of certain chromosomes may be terminal. General and specific distinctions in morphology definitely separate portions of the *longiflora* chromosome complex from portions of the *alata* complex.

J. L.

X-radiation of *Nicotiana*.—T. H. GOODSPEED ("Inheritance in *Nicotiana tabacum*. IX. Mutations following Treatment with X-rays and Radium," *tom. cit.*, 1930, 285-98). Treatment of *Nicotiana tabacum* var. *purpurea* with X-rays and radium induces three recessive monogenic mutations. These involve pink flower colour, pistillody of the andræcium, and albino seedlings.

J. L.

X-radiation of *Nicotiana*.—T. H. GOODSPEED ("Occurrence of Triploid and Tetraploid Individuals in X-ray Progenies of *Nicotiana tabacum*," *tom. cit.*, 299-308). In an assemblage of plants of *Nicotiana tabacum* representing products

of treatment with X-rays, one triploid *N. tabacum* var. *purpurea*, and one tetraploid, var. "Maryland Mammoth," have been found. The derivations of these plants are given. The exact number of chromosomes in the triploid *tabacum* was not determined with certainty, but was probably the full triploid complement. Thirty-six units were usually present at first metaphase, and could be classified as 12 trivalents, 12 bivalents and 12 univalents. The first meiotic division was comparatively regular, but a large amount of chromosome lagging occurred at homotypic division. In the tetraploid plant quadrivalents, trivalents, bivalents and univalents appeared at first metaphase, giving a total of from 96 to 98 chromosomes. Meiotic irregularities were observed, some of which might possibly lead to the formation of somatic gametes.

J. L.

Chromosomal Variation in *Crepis*.—M. NAVASHIN ("Unbalanced Somatic Chromosomal Variation in *Crepis*," *Univ. Calif. Pub. Agr. Sci.*, 1930, 6, 95-106). A sectorial chimera with one part trisomic and the other normal diploid was found among plants of a triploid progeny of *Crepis tectorum*. This plant consisted of three shoots. Two were simple trisomics of the triplo-B type, the third diploid of normal appearance. The trisomic shoots were dwarfed and had 9 chromosomes, whereas the normal shoot had the typical four pairs. The diploid shoot showed greatly reduced fertility for no apparent cause. No meiotic irregularities were observed. A case of "chromosomal variegation" in *C. tectorum* is described, and an explanation given of the origin of the sectorial chimera.

J. L.

Cytology of *Crepis* Hybrids.—LILLIAN HOLLINGSHEAD ("Cytological Investigations of Hybrids and Hybrid Derivatives of *Crepis capillaris* and *Crepis tectorum*," *tom. cit.*, 55-94). In the F_1 hybrid of *C. capillaris* ($n = 3$) and *C. tectorum* ($n = 4$) the somatic chromosomes show that the satellite on one chromosome of *tectorum* is not present in the hybrid. In the reciprocal hybrids another *tectorum* chromosome is shorter than in the parental species. Meiosis in *tectorum* is normal, but in plants of the X-strain of *capillaris* may be very irregular. All F_1 hybrids show variation in the number of bivalents at heterotypic metaphase. Three bivalents and one univalent were most frequently seen, and seven univalents were rare. The combinations varied according to the strain of the parental species involved. The univalent chromosomes divided either at first or second anaphase, but not at both. The hybrids were almost completely sterile. Several triploid hybrids were found among ordinary F_1 hybrids. These contained a diploid set of *capillaris* and a haploid set of *tectorum* chromosomes. The *capillaris* chromosomes formed three bivalents, and the *tectorum* chromosomes remained unpaired. Selfed progenies were obtained from the triploids. Their chromosome constitutions indicated that only male gametes which had none or all the *tectorum* chromosomes functioned, but all the female gametes could function. One completely sterile amphidiploid derivative was secured.

J. L.

Chromosomes and Phylogeny in *Crepis*.—LILLIAN HOLLINGSHEAD and E. B. BABCOCK ("Chromosomes and Phylogeny in *Crepis*," *tom. cit.*, 1-53). The number and morphology of the somatic chromosomes of 70 species of *Crepis* have been investigated. The known series of chromosome numbers of Old World species is 6, 8, 10, 12, 14, 15, 16 and $40 \pm$. That of the American species is 14, 22, 33, 44, 55 ? and 88 ?. Some are obviously members of a polyploid series; others probably originated through interspecific hybridisation. Evidence points to 10 as the basic number. Variation in chromosome sizes is distributed throughout the genus and not peculiar to any one subgenus. There is a general similarity in

all the species with regard to the shape of the chromosomes. A chart is given showing the four major subdivisions of the genus and the chromosome numbers of the species discussed. The chart depicts the phylogenetic groups which were worked out by combining data on chromosome number and morphology with evidence from external morphology, consideration having been given to geographical distribution and evidence from interspecific hybridisation. It is concluded that in *Crepis* there is a fairly close parallelism between number and morphology of the chromosomes and phylogenetic relationship. J. L.

Chromosome Numbers in *Dianthus*.—T. ISHII ("Chromosome Studies in *Dianthus*—I," *Cytologia*, 1930, 1, 335-9). The diploid chromosome numbers are given for 24 species of *Dianthus*. In ten of these $2n = 30$, in two $2n = 60$, and in the remaining twelve $2n = 90$. The basic number is thus 15. A relation exists between the number or volume of chromosomes in different species and the size or weight of their seeds. J. L.

Chromosomes of *Cucumis*.—Z. A. KOZUCHOV ("Karyological Investigations of the genus *Cucumis*," *Bull. Applied Botany, Genetics and Plant Breeding*, 1930, 23, 357-66, Russian with English summary). All the investigated members of the genus *Cucumis* have the same karyotype possessing $2n = 24$ chromosomes. *Cucumis sativus* L. with $2n = 14$ chromosomes is the only exception. The shape of the chromosomes and the absence of polyploid forms among the species investigated confirm the opinion of Prof. Levitsky that the process of karyophylogenesis of the genus *Cucumis* took place through the segmentation of the chromosomes of the cucumber type. The rôle of the small kernel in the process of karyokinesis of the genus *Cucumis* confirms its reputation as a storage of nutritives for the chromosomes. J. L.

Cytology of Intersexual Plants of *Rumex*.—T. ONO ("Further Investigations on the Cytology of *Rumex*. VI. On the Intersexual Plant of *R. Acetosa*. VII. Chromosomes of *R. montanus*. VIII. Chromosomes of an Intersexual Plant of *R. Acetosella*," *Bot. Mag., Tokyo*, 1930, 44, 168-76, Japanese with English summary). The intersexual plant of *R. Acetosa* bears male, female, and bisexual flowers. The latter show various degrees of degeneration. The degrees of intersexuality in each plant have been determined by calculating the p.c. of bisexual flowers. Out of 50 different intersexual individuals, 9 had 15 chromosomes (diploid), 40 had 22 (triploid), and 1 had 29 (tetraploid). Among the progenies of triploid intersexual plants, 15-, 16-, and 20-chromosomal individuals were found. The numbers of diploid chromosomes in female, male, and intersexual plants of *R. montanus* were determined respectively to be 14, 15 and 22. The following chromosomal formulæ are suggested: ♀ $14 = 12x + 2x$, ♂ $15 = 12a + X + 2Y$, ♂ $22 = 18a + 2X + 2Y$. An intersexual plant of *R. Acetosella* was found to have 20 bivalents and one univalent at heterotypic division. One or more tetrapartite rings are formed by association of the bivalents with each other. J. L.

Chromosome Numbers.—L. O. GAISER ("Chromosome Numbers in Angiosperms—II," *Bibliographia Genetica*, 1930, 6, 172-466). A list of chromosome numbers embodying the results of investigations to the end of the year 1928. The arrangement of species under families and orders is according to Engler and Gilg. The species and varieties are listed in alphabetical order. J. L.

Asynapsis in *Zea Mays*.—G. W. BEADLE ("Genetical and Cytological Studies of Mendelian Asynapsis in *Zea Mays*," *Cornell Univ. Agr. Exp. Sta., Memoir* 129, 1930). A case of non-synapsis of the meiotic chromosomes of *Zea Mays* has been

attributed to the presence of a Mendelian recessive gene. Meiosis in the microsporocytes of asynaptic plants is characterised by partial or complete failure of synapsis during prophase of the heterotypic division. The first division results in very irregular distribution of univalent chromosomes or complete failure of reduction. This latter results in the production of diploid spores. Asynaptic plants are distinguished by complete pollen sterility and variable female sterility. Progenies resulting from the cross asynaptic by normal show that megaspores of asynaptic plants are often diploid. Kernels with triploid embryos produced on asynaptic plants are about one-fourth the weight of kernels with diploid embryos formed on the same plant. A discussion is given regarding the possible relation of the asynaptic gene to synapsis, crossing-over, hybrid chromosome behaviour, apomixis and the production of autopolyploids. J. L.

Pollen-Tube Growth in *Datura*.—J. T. BUCHHOLZ and A. F. BLAKESLEE ("Pollen-Tube Growth in Crosses between Balanced Chromosomal Types of *Datura Stramonium*," *Genetics*, 1929, **14**, 538–68). Abnormalities in pollen-tube growth such as swollen ends and burst pollen-tubes within the style are regarded as indicative of unfavourable conditions for pollen-tube growth. A high proportion of ungerminated pollen remaining on the stigma is an indication of unsuitable genetic constitution of the pollen. Styles of n , $2n$ and $3n$ plants were found unsuited to the growth of pollen-tubes coming from the pollen of $4n$ plants. Styles of n , $2n$, $3n$ and $4n$ plants were found favourable for the growth of $2n$ pollen. Pollen of tetraploid plants gave about 75 p.c. germination on tetraploid stigmas, and about 85 p.c. on $3n$, $2n$ and n stigmas. Considerable numbers of abnormal pollen-tubes due to bursting were found in $4n \times 4n$ tests. Triploid pollen gave very little germination either on $3n$ stigmas or those of $2n$ or $4n$ plants. From 60–70 p.c. of the small proportion of mature pollen-grains produced in a haploid may germinate on the stigma of $4n$, $3n$, $2n$ and n types. Three hypotheses are put forward suggesting the nature of the ungerminated haploid pollen: some may contain new genes which are lethal in the male gametophytic stage; some may be pollen-grains with 13 chromosomes; some may be grains with 11 chromosomes arising from pseudo-reduction. J. L.

Anatomy.

Sex-Differentiation and Flower Anatomy of *Firmiana simplex* Wight.—TSU-KIANG NYI ("Observation on the Sex-Differentiation and Flower Anatomy of *Firmiana simplex* Wight," *Contr. Biol. Lab. Sc. Soc. China*, **5**, 1–25, 16 figs.). A study of "the ontogeny of the carpel with respect to the mechanism of its dehiscence," together with the development and abortion of the sexual organs. All the flowers were found to be unisexual, but the staminate flowers have rudimentary pistils and the pistillate flowers sterile stamens, so that both appear to be hermaphrodite. In the staminate flower the embryo-sac may form seven nuclei before disintegration, while in the pistillate flowers microspores may form but never germinate. The functionless ovules have only slight traces of vascular bundles, and in the abortive carpels the main strands never develop. At first the carpel is open, but is soon closed by growth and fusion of cells on either side of the slit. As in other Angiosperms, the ovules are borne on the adaxial surface of the carpel. S. G.

Pollen-Grains in Identification and Classification of Plants.—R. P. WODEHOUSE ("Pollen-Grains in the Identification and Classification of Plants. V. *Haplopappus* and other *Astereæ*: the Origin of their Furrow Configurations,"

Bull. Torrey Bot. Club, 1930, **57**, 21-46, 1 pl., 24 figs.). An investigation of the pollen-grains in different tribes of the Compositæ to discover the origin, phylogenetic distribution, and evolutionary trend of their forms. The present paper deals with all those *Astereæ* which can be included under the generic name *Haplopappus*. Forty-eight species from North and South America were examined. The smallness of variation in the emphytic characters of the pollen-grains is entirely in keeping with the close relationship believed to exist between all these species, and the interrelationships are so close that the differences do not appear in the structure of the pollen-grains. The haptotypic characters, however, show an enormous difference, not only among different species, but also among different individuals of the same species and even the same plant. The typical form of pollen-grain is similar to that of the grains of most Compositæ. In attempting to use pollen-grains in classification, it is necessary to distinguish between those characters belonging to the grain's own independent organisation (emphytic) and those resulting from interaction with its fellows (haptotypic). The monotonous similarity throughout the genus *Haplopappus* and most of the *Astereæ* sustains the idea of genetic continuity. The haptotypic characters, as represented by the number and arrangement of furrows, reveal underlying laws controlling their configurations. An important factor in determining the number of furrows is the arrangement of the grains in tetrads, etc.—the points of contact are closely connected with the number of furrows. The largest number of furrows seen in the species examined was twelve. "Supernumerary furrows and their configurations on the surface of the pollen-grain are due to stresses set up in the grain by contact-stimuli at two points in the tetrad." S. G.

Structure of Seed-Coat of Albizzia.—F. G. ELFORD ("The Palisade Cells of the Seed-Coat of *Albizzia lophantha*," *Proc. Roy. Soc., Victoria*, 1930, **42**, New Ser., pt. 2, 92-8, 3 figs.). A study of the epidermal palisade cells of the seed-coat of *Albizzia*. Previous work had shown that the seed-coat consists of (1) a cuticle composed of pure cutin; (2) an epidermis of palisade cells, the outer part of which is cuticularised and the inner part with walls of unaltered cellulose; (3) a row of hour-glass cells; (4) inner layers of integument composed of hemicellulose. By use of hydrofluoric acid prior to embedding, and subsequent staining with light green and safranin, the structure of the testa could be clearly seen. The epidermis is composed of a single layer of palisade cells, each of which contains a highly transparent globule of a waxy nature. These globules dissolve slowly in wax solvents, can be stained like fats, and have a high melting-point. A layer of hour-glass cells separates the epidermis from the inner parts of the integument. S. G.

Formation of Tyloses and Obliteration of Spiral Vessels.—W. G. ALEXANDROVA and O. G. ALEXANDROVA ("Über Thyllenbildung und Obliteration bei Spiralgefässen," *Beit. zur Biol. d. Pflanzen*, 1929, **17**, 393-403, 6 figs.). The development of tyloses and the obliteration of spirally thickened vessels were demonstrated in the petioles of the lower leaves of female hemp plants (*Cannabis sativa*) in the fruiting stage. The process of obliteration begins with a loosening of the spiral thickening of the vessel wall, followed by delignification of the spirals, disintegration and finally complete disappearance. The formation of tyloses is succeeded by disintegration of the spirals, delignification and disappearance. Finally all trace of a vessel is lost. The consequences of the two processes of tylose-formation and obliteration of the vessels are identical. The structure of the vessels and the condition of the spiral thickenings at the time determined which of the two processes shall take place. B. J. R.

The Seedling and Young Plant of the Pineapple.—E. N. MILES THOMAS and L. E. HOLMES ("The Development and Structure of the Seedling and Young Plant of the Pineapple (*Ananas sativus*)," *New Phyt.*, 1930, 29, 199–226, 31 figs.). The seed is small, with a pointed end and one flat side, ribbed by unequal development of the middle layer of the testa. The endosperm contains starch grains and proteid granules, while the embryo itself stores oil also. The embryo is small and is placed obliquely at the pointed apex, and consists almost entirely of cotyledon. Germination is of the normal hypogeal type. The form of the cotyledon is simple, with a cylindrical distal absorbing region and proximal asymmetrical short sheathing base. Growth starts in the cotyledon; later the cells of the radicle become active and finally the plumule emerges from the cotyledonary sheath. At the end of one month the cotyledon shows a single collateral strand throughout its entire length, but the phloem and xylem are somewhat separated. The protoxylem is exarch. The first plumular leaf also has only one strand which is less differentiated than that of the cotyledon. The hypocotyl and the base of the root show an approximation of these strands, resulting in two phloem groups, the one a continuation of that of the cotyledon, and the other of that of the first plumular leaf. The root in a later formed part shows 3–4 xylem groups in its diagonal planes and an equal number of alternating phloem groups. At three weeks there is no vascular structure in the plumular position, and that in the cotyledonary position is only discernible below the cotyledonary node for a short distance. The independent adult form is established at about three months. Plumular leaves and adventitious roots are continually being added. The former show numerous vascular strands supported by sclerenchyma, no midrib, a water-storing hypoderm on the upper surface, and an elaborate covering of peltate hairs on both surfaces. The adventitious roots may have numerous xylem poles, apparently correlated with diameter, and generally develop a sclerotic middle cortex, a sclerised pith and a much thickened endodermis. In certain short roots of large diameter these may be missing. Both the epicotyledonary and the hypocotyledonary axes are very short. The plumular axis develops, at about the level of the insertion of the second leaf, a curious cylinder of meristematic cells in the region, the pericycle consisting of several cell layers. Immediately below and to the outside of this cylinder is a well-developed endodermis. This constitutes a distinct "stellar" structure.

B. J. R.

A New Species of Cupressinoxylon.—H. J. LUTZ ("A New Species of *Cupressinoxylon* (Göppert) Gothan from the Jurassic of South Dakota," *Bot. Gaz.*, 1930, 90, 92–107, 13 figs.). A new species, *Cupressinoxylon jurassica*, the oldest that has been certainly referred to the genus, is described and figured. The determination is based on a microscopic study of ten thin sections and comparison with fossil and living coniferous woods. So far as living genera are concerned, the fossil agrees closest with *Cupressus* and *Chamaecyparis*. It has the structure of a strictly modern conifer type in all respects.

B. J. R.

Mesoxylon platypodium and Mesoxylroides.—A. J. MASLEN ("The Structure of *Mesoxylon platypodium* and *Mesoxylroides*," *Ann. Bot.*, 1930, 44, 503–34, 4 pls., 1 fig.). The structure of two stems, *Mesoxylon platypodium* and *Mesoxylroides platypodium* (gen. et sp. nov.), from the Lower Coal Measures of Lancashire, is described in detail and summarised in diagnoses. The genus *Mesoxylon* was founded in 1910 for a number of forms referred to the Cordaites, and considered to be the last link in a chain of fossils connecting the Pteridosperms and the typical Cordaites. *Mesoxylon platypodium* is the only form not hitherto described in detail.

Outstanding characters of the species are the wide separation (about 2 mm.) of the paired leaf-trace bundles on the margin of the pith, the division of the centripetal xylem of each bundle before leaving the pith margin, and the presence of two axillary steles (corresponding to a single leaf) in the pericycle and cortex. A new genus, *Mesoxylodes*, is made for the reception of a stem evidently closely related to *Mesoxylon*, but differing from it in the possession of three-bundled asymmetrical perimedullary leaf-traces. The specific name *platypodium* has been given because in general characters it is nearer to *Mesoxylon platypodium* than to any other species of the genus. Detailed comparison shows, however, that it differs from *Mesoxylon platypodium*, not only in the number of bundles in the leaf-traces and in the large number of axial steles, but also in the much wider separation (4 mm.) of the leaf-trace bundles, the early division of both centripetal and centrifugal xylem, and in a number of minor characters.

B. J. R.

General.

The Geographical Distribution of *Larix*.—C. H. OSTENFELD and C. S. LARSEN ("The Species of the genus *Larix* and their Geographical Distribution," *Det. Kgl. Danske Vidensk. Selsk., Biol. Medd.*, 1930, 9, 2, 1-106, 35 figs., 8 maps). The natural distribution of the various species of *Larix* is dealt with in detail. The authors recognise ten species and three geographical varieties. The species *L. Griffithiana*, *L. Mastersiana*, *L. Potanini*, *L. occidentalis* and *L. Lyalli* constitute a natural subgenus, characterised by the bracts of the cone being longer than, and reaching out of, the cone-scales. All these species have restricted areas of distribution, being mountain trees from the mountain regions of western North America and south-eastern Asia respectively. *L. occidentalis* is the only one of this group of any economic value, but none of them have hitherto been cultivated on a large scale. The five other species are *L. Kämpferi* (*L. leptolepis*), *L. Gmelini* (*L. dahurica*), with the varieties *olgensis* and *Principis-Rupprechtii*, *L. sibirica*, *L. decidua* (*L. europaea*), and *L. laricina* (*L. americana*). Of these, *L. Kämpferi* is distributed over a small area on Hondo, Japan, while *L. decidua* has a medium-sized area. *L. Gmelini*, *L. sibirica* and *L. laricina*, on the other hand, cover very large areas, the last inhabiting the northern temperate and sub-arctic zones of North America. *L. Gmelini* and *L. sibirica* divide Eurasia between them; the former occurs in Eastern Asia and as far west as from Lake Baikal northwards; the latter in the area west of *L. Gmelini*, as far west as North-East Europe. The differences between the species and their variability are considered under each species; their synonymy and the records of the specimens upon which the author's conclusions are based are cited in full. The two geographical varieties of *L. Gmelini* form a kind of transition to the first-named subgenus. The variety of *L. decidua* var. *polonica* is a link between that species and *L. sibirica*, and is a form which appears to be near extinction. The species of the second subgenus are of importance as forest trees, and several of them have been extensively cultivated. Hybridisation within the genus has been recognised in nature and in cultivation.

B. J. R.

Chinese Pines.—L. CHENG ("A Study of Chinese Pines," *Contr. Biol. Lab. Sci. Soc. China*, 1930, 6, 2, 5-21). The paper is part of an attempt to bring together all the conifers so far known from China for general reference and further systematic study. Nine species and one variety are described, with their synonymy and references, namely, *P. Armandi* Franch., *P. Bungeana* Zucc., *P. tabulaeformis* Carr., *P. tabulaeformis* var. *densata* Rehd., *P. Massoniana* Lamb. and *P. yunnanensis* Franch. The description of a new species, *P. Yamazutai* Uyeki, is also reproduced. A key to the Chinese pines is given.

B. J. R.

CRYPTOGAMIA.

Pteridophyta.

Distribution and Phylogeny of *Equisetum*.—JOHN H. SCHAFFNER ("Geographic Distribution of the Species of *Equisetum* in Relation to their Phylogeny," *American Fern Journ.*, 1930, **20**, 89–106). After a brief consideration of the ancestors of *Equisetum* in geological epochs, the author gives a phylogenetic synopsis of the species existing at the present time, ranging them in six defined groups, the oldest of which is placed first:—(1) Primitiva (*E. xylochatum*, *E. giganteum*); (2) Hiberna (*E. ramosissimum*, *E. debile*, *E. hiemale* and others); (3) Ambigua (*E. kansanum*, *E. Funstoni*); (4) Pusilla (*E. variegatum*, *E. scirpoides* and others); (5) Aestivalia (*E. fluviatile*, *E. palustre* and others); (6) Heterophyadica (*E. sylvaticum*, *E. pratense*, *E. telmateia*, *E. arvense*). He adds a list of fifteen evolutionary advances made in these groups of species in passing from *E. xylochatum* up to *E. arvense*. As to distribution of the genus, no species occur in Australia and New Zealand, nor in the more isolated islands of the Indian Ocean and South Atlantic. The Asiatic *E. debile* alone has penetrated to the East Indies and some of the Pacific islands. South Africa has but one species, *E. ramosissimum* from Eurasia. America has all but 4 of the 22 recognised species. The distribution of the genus in America is very interesting when studied in detail. The great river basin of the Amazon is almost destitute of *Equisetum*. The Primitiva extend along the Andes from Argentina and Chile to Venezuela, and in Eocene times *E. giganteum* spread along the land-bridge to Jamaica, Cuba, and Haiti. The distribution of the members of the other groups is mostly of a more intricate nature, and is best studied in the author's account. A. G.

Hybridism in *Selaginella*.—JEANNETTE E. GRAUSTEIN ("Evidences of Hybridism in *Selaginella*," *Bot. Gaz.*, 1930, **90**, 46–74, 53 figs.). Evidences of hybridism include:—(1) Aberrancies of habit, such as bifurcated cones and apical reversion of the cone to a vegetative condition. (2) Method of spindle formation. (3) Mother-cells lacking in concerted action or failing to divide. (4) Meiosis is difficult to follow, through scarcity of divisions, smallness of mother-cells, abundance of chromatin-like bodies in the cytoplasm. (5) Irregular heterotypic division in *Selaginella amœna*, and to some extent in *S. apoda*. (6) Two aberrant types of division predominant in *S. mandaiana*. (7) *S. rupestris* is apogamous, is almost exclusively megasporangiate, has a comparatively high chromosome number, and forms its microspores in dyads like many apogamous angiosperms. (8) Many of the species examined produce sterile spores. (9) No advanced stages of development of male gametophytes were seen except in occasional spores of *S. apoda*. A. G.

Cyatheaceous Prothallia.—ALMA G. STOKEY ("Prothallia of the Cyatheaceæ," *tom. cit.*, 1–45, 186 figs.). An investigation carried on for several years as to the prothallia of representative species of the Cyatheaceæ. (1) It was found that after germination the plate stage is quickly reached, and usually no filament is left at the base of the prothallium. The mature prothallium is larger than in Polypodiaceæ. Forking occurs in old cultures. (2) Multicellular hairs were abundant on prothallia of *Alsophila*, *Hemitelia*, *Cyathea* and rarely on *Lophosoria*, but not at all on *Thyrsopteris*, *Culcita*, *Cibotium*, *Dicksonia*. The multicellular hair arises from a special initial near the apical meristem, and occurs on both surfaces, but not on or near the margin. (3) The wall of the antheridium typically consists of

five cells. In *Lophosoria* the antheridia are larger and less symmetrical than in *Alsophila*, *Hemitelia*, *Cyathea*. In *Thyrsopteris* they are the largest and least symmetrical of the family. The Dicksoniæ usually have antheridia larger than those of the Cyatheæ. (4) As to the archegonia, the necks in the Cyatheæ are straight or slightly curved; they are longer and are composed of more cells than in the Polypodiaceæ. In the Dicksoniæ and *Thyrsopteris* they are longer and more recurved than in Cyatheæ. The walls of the neck cells are more or less cutinised. The neck contains two neck canal nuclei not separated by a wall; in all species four neck canal nuclei may occur. (5) Apogamous growths were found in *Lophosoria quadripinnata*, *Alsophila excelsa*, *A. armata*, *Hemitelia parvula*, *Cyathea medullaris*, *C. dealbata*, *Thyrsopteris elegans*, *Dicksonia squarrosa*, *Cibotium Barometz*, and *C. Schiedii*. (6) The evidence from the gametophyte indicates that the family Cyatheaceæ, in the broader sense, is not a natural group, but is of polyphyletic origin. A. G.

Punctate Ferns.—K. GOEBEL ("Archegoniatenstudien. XX. Farne mit punktierten Blättern," *Flora*, 1930, N.F. 24, 410-22, 7 figs.). Some species of *Polypodium* sometimes show on the under-surface of their rather coriaceous fronds punctations which are not to be mistaken for the hydathodes of the upper surface. These punctations are prosori—that is, they mark the spots where, under favourable conditions, the sori occur. They consist of a mass of small celled tissue and the swollen end of a veinlet; they are charged with reserve materials. They occur much more on cultivated specimens than on wild plants, conditions for spore-formation being unfavourable in the former. The prosori are arrested organs. A. G.

Sumatra Ferns.—O. POSTHUMUS ("Notes on Pteridophyta from Djambi, Sumatra," *Koninklijke Akad. van Wetenschappen te Amsterdam*, 1928, 31, 95-112). A list of 74 ferns and 11 fern allies collected by the author in the interior of Sumatra. The distribution of these is discussed, and conclusions are drawn that the fern flora of Sumatra differs less from those of Malacca and Borneo than from that of Java. A. G.

Bryophyta.

Exormotheca.—C. V. B. MARQUAND ("A New Species of *Exormotheca* from South Africa," *Kew Bull.*, 1930, 237-9, 3 figs.). *Exormotheca megastomata* is described as a new species of thalloid hepaticæ from the Transvaal, allied to *E. africana* Steph., but differing markedly in the stomata elevated on tall tubular assimilating chambers on the dorsal surface, and in the ventral scales not being ciliate. Only the sterile plants were obtained, and these, despite desiccation and a long voyage, were found to be still alive. A. G.

Marchantia and Plagiochasma.—FRIEDRICH MENGE ("Die Entwicklung der Keimpflanzen von *Marchantia polymorpha* L. und *Plagiochasma rupestre* (Forster) Stephani," *Flora*, 1930, N.F. 24, 423-78, 5 pls., 7 figs.). An account of the development of the sporelings of *Marchantia polymorpha* and *Plagiochasma rupestre*. The method of cultivating the spores and sporelings, and the fixing, staining and delineation of the latter are described. In *Marchantia* the development of a number of young thalli is figured, and the subsequent lines of development followed by certain points of the young thallus are ingeniously traced out on the older thallus. Dichotomy occurs after three or four weeks; but at that time the differentiation of tissues is very slight, and the air chambers are not formed till

later. The development of the young thallus of *Plagiochasma* is less easily traced by vertical observation from above. The rudiments of air chambers are to be seen in very young thalli. A. G.

American Scapaniæ.—ALEXANDER W. EVANS ("Three Species of *Scapania* from Western North America," *Bull. Torrey Bot. Club*, 1930, 57, 87-111, 8 figs.). Three species of *Scapania* from western North America are discussed in the light of H. Buch's treatise on the Scapaniaceæ of North Europe and Siberia, published in Comm. Biol. Soc. Sci. Fennica 1922 and 1928. Buch divided the genus into three subgenera, one of which—*Euscapania*—contains thirteen sections based on definite combinations of characters. Evans discusses *Scapania Bolanderi* Aust., which flourishes from Alaska to California and in Japan; *S. americana* K. Müll., found from Alaska to California; and *S. granulifera*, a new species from California, allied to *S. americana* and the Japanese *S. parvilexta*. A. G.

Frullaniaceæ of Oceania.—FR. VERDOORN ("Revision der von Ozeanien angeführten Frullaniaceæ (De Frullaniaceis VIII)," *Nederlandsch Kruidkundig Archief*, 1930, 155-75, 2 figs.). A revision of 38 species of *Frullania*, with notes on many others referring them to synonyms of older species. A. G.

Bruchia vogesiaca.—CL. SARRASSAT ("Note sur le *Bruchia vogesiaca* Schw., Mousse nouvelle pour la Creuse," *Rev. Bryol.*, 1930, 3, 62-4). An account of the distribution of *Bruchia vogesiaca* in France and of the special conditions in which it has been found, and of the species with which it is associated. At the new stations in the Department of the Creuse it occurs in good quantity. A. G.

Barbula rufa.—CH. MEYLAN ("*Barbula rufa* (Lor.) et *B. Kneuckeri* (Loeske et Osterw.)," *Bull. Soc. Bot. Genève*, 1930, 21, 264-7). A critical revision of the characters which distinguish *Barbula rufa*, *B. Kneuckeri*, and *B. reflexa* from one another, with a key in which the points of difference are made clear—the size of the cells, the nature of the basal cells and basal margins, also the squarrose leaves in *B. reflexa*. A. G.

Rhacomitrium sudeticum.—W. R. SHERRIN ("*Rhacomitrium sudeticum* B. & S.," *Journ. Bot.*, 1930, 68, 304-5, 2 figs.). The characters by which this moss is distinguished from *R. heterostichum* var. *gracilescens* are briefly and clearly contrasted, thus removing a source of confusion in British bryology. A. G.

Orthodicranum Allorgei.—H. REIMERS ("Über *Orthodicranum Allorgei* Amann et Loeske, *Dicranum canariense* Hpe. und *D. Scottianum* Turn.," *Rev. Bryol.*, 1930, 3, 51-61, 2 pls.). The author discusses the relationships and synonymy of the above mosses, and concludes that *Dicranum Scottianum* Turn. includes two subspecies: (1) *anglicum* Reim., found in North-West Europe; (2) *canariense* (Hpe.) Corb., found in Spain, Madeira, Canaries, Azores, and including *D. canariense*, *D. erythrodontium*, *Orthodicranum Allorgei*. The leaves of the former are entire, and on the back of the apex of the costa are paucidentate, while the leaves of subsp. *canariense* have the margins and costa-back dentate down to quarter or half their length. A. G.

Acanthocladiella and Heterophyllum.—R. POTIER DE LA VARDE and I. THÉRIOT ("Recherches sur les affinités du genre *Acanthocladiella*," *tom. cit.*, 5-11, 1 pl.). *Acanthocladiella* was created by Fleischer in 1914 for a moss from Madagascar which had been referred to *Microthamnium* and two other genera. Three other species became added to it, and then one of these, *A. congoana*, was found to be identical with *Heterophyllum guineense* Broth., which also was previously

referred to two other genera. This has led to a number of intricate investigations of the species attributed to the two genera, especially of the question whether paraphyllia and propagula characterise all the species. The result is that the two genera are not distinct; their affinities are with the subfamilies Heterophylloideæ and Clastobryoideæ. The genus *Acanthocladiella* is suppressed in favour of the older *Heterophyllum*. A. G.

Oceanic Bryophyta in North Alps.—H. GAMS ("Schisma Sendtneri, *Breutelia arcuata* und das *Racomitrium lanuginosi*," *tom. cit.*, 12–30, 1 pl., 4 figs.). The author discusses the significance of the occurrence of *Schisma Sendtneri*, *Breutelia arcuata*, and other bryophyta of an oceanic type in the alps of Tyrol, and the conditions of climate, altitude, plant associations, etc., in which they are found. The question of whether they are relics of a glacial period is considered. A. G.

Morvan Bryophyta.—ABBÉ GUILLAUMOT ("Notes bryologiques sur le Morvan," *tom. cit.*, 74–9). A list of 197 mosses, 23 sphagna, and 69 hepatics collected in the Morvan, a mountain district in the Departments Yonne and Nièvre, characterised by immense forests and abundant streams, the moss flora of which had been insufficiently studied. A. G.

Iberian Bryophyta.—PIERRE ALLORGE ("Notes sur la flore bryologique de la Péninsule ibérique. IV. Sur quelques muscinées intéressantes de la vallée de Bidassoa," *tom. cit.*, 80–7, 1 fig.). The distribution of *Dumortiera hirsuta* in Western Europe is indicated and figured, and a number of other rare hepatics and mosses from the north of Spain are recorded, with some notes on their ecology and distribution. Appended is an account of the discovery of the very rare hepatic *Riccinia perennis* (Steph.) Trabut, of the bush-land in which it was found, and of the bryophyta and other plants with which it was associated. A. G.

Congo Mosses.—I. THÉRIOT ("Mousses du Congo Belge et du Libéria récoltées par D. H. Linder," *tom. cit.*, 30–50, 14 figs.). A list of 75 mosses from the Belgian Congo, 3 from Uganda, and 41 from Liberia, collected by D. H. Linder during the expedition of the Harvard Institute of Tropical Biology and Medicine in 1926–27. Among them are 14 new species and some varieties described for the first time. A. G.

Thallophyta.

Algæ.

Protoplasm of Algæ.—PIERRE DANGEARD ("Observations vitales sur le protoplasme des algues," *C.R. Acad. Sci., Paris*, 1930, **190**, 1576–9, 6 figs.). The living protoplasm of only *Spirogyra* and *Vaucheria* had been previously and adequately studied among the algæ. The author has investigated several other transparent filamentous algæ and diatoms, and gives his results. In *Zygnema* and *Mougeotia* the cytosomes are extremely slender filaments, able to curve and move slowly; they are accompanied by minute round granules which circulate rapidly without Brownian movement. In *Spirogyra* such granules are abundant locally. In *Closterium* they circulate in the active currents and exhibit rapid secondary movements in relation to one another. Filamentous cytosomes have been observed in marine diatoms (*Liomphora*, *Coscinodiscus*). In *Rhizosolenia* the rod-like cytosomes are very evident, and are carried along in the longitudinal currents, but less quickly than the granules. Similarly, in certain Florideæ (*Callithamnion*, *Ceramium*) rod-like and filamentous cytosomes are to be seen. In Phæophyceæ (*Ectocarpus*) the very slender filamentous cytosomes are difficult to see. Though

apparently absent in some transparent algæ, it may possibly be that the cytosomes are here less visible. In cases where they are very evident their physical characters are identical with those of cytosomes found in phanerogams. A. G.

Wharfe Plankton.—W. LAWRENCE SCHROEDER ("Biological Survey of the River Wharfe. III. Algæ Present in the Wharfe Plankton," *Journ. Ecology*, 1930, **18**, 301-5). A list of the plankton algæ gathered in the summer of 1926 at three stations on the River Wharfe, in the West Riding of Yorkshire, with an indication of their frequency of occurrence at each station from June to September. The numbers of species enumerated are 35 Chlorophyceæ, 60 Bacillariales, 6 Myxophyceæ. A. G.

Euglena.—PIERRE DANGEARD ("Sur une euglène incolore du groupe de l'*Euglena acus* (*Euglena acus* var. *pallida* nov. var.," *Le Botaniste*, 1930, **22**, 1-14, 1 pl.). The author discusses what is known of members of *Euglena* which are deprived of chlorophyll, and describes a new variety *pallida* of *E. acus*, which is plentiful in a peat bog, Roc de Chère, near Annecy, and which contains no chlorophyll. A. G.

Gonium in Culture.—P. A. DANGEARD ("Observations sur la culture du *Gonium sociale* en différents milieux nutritifs liquides ou solides," *tom. cit.*, 80-99, 2 pls.). The author reproduces a short preliminary paper published by him in 1916 on the culture of *Gonium sociale*, and adds fuller details as to the media employed—(1) liquid media, namely, Errera's calcic liquid and Grintzesco's liquid; (2) solid media, namely, Grintzesco's nutritive medium with gelose, and a nutritive medium with gelose and glucose. He describes and figures the various forms of colonies, cells, motile and resting spores found in the various cultures, and also the variations observed in the cytoplasmic structure. A. G.

Cyanophyceæ and Bacteria.—JESSIE JONES ("An Investigation into the Bacterial Associations of Some Cyanophyceæ, with Especial Reference to their Nitrogen Supply," *Ann. Bot.*, 1930, **44**, 721-40). An investigation of the source of the nitrogen in Cyanophyceæ which flourish in sandy wastes. Some previous authors have detected the agency of bacteria, others believed that the alga can fix nitrogen. The present investigation shows that nitrogen-fixing bacteria inhabit the mucilaginous coat of some algæ to the mutual benefit of both organisms. The methods adopted in the investigation are described. Cultures of *Rivularia* and *Nostoc* were made on sand with various solutions, and of *Glæocapsa* on sand in sea-water, all being in flasks plugged with cotton-wool. After some time the flasks were tested for nitrogen, and an appreciable increase was found. The presence of bacteria in the algal mucus was revealed by the microscope. The bacteria when cultivated were found capable of fixing much atmospheric nitrogen. Some well-known nitrogen-fixing organisms, such as *Azotobacter chroococcum*, *Clostridium pastorianum*, and *Bacillus radicola*, were present in large numbers. A. G.

Stigonemaceæ.—ABBÉ P. FRÉMY ("Les Stigonemacées de la France," *Rev. Algol.*, 1930, **5**, 147-213, 9 pls., 35 figs.). A monograph of the Stigonemaceæ of France, arranged in 13 genera, with keys to the species, specific descriptions, synonymy, iconography, distribution, etc. A. G.

Scytonema.—YAJNAVALKYA BHARADWAJA ("*Scytonema Malaviyaensis*, sp. nov.," *tom. cit.*, 223-8, 1 pl.). A description and figures of *Scytonema Malaviyaensis*, which is epiphytic on *Mangifera* at Benares in summer. A. G.

Heterocysts of *Cylindrospermum*.—KATHLEEN M. DREW (Mrs. BAKER) ("The Occurrence of Heterocysts and Spores at Both Ends of the Filament in the genus *Cylindrospermum* Kütz.," *tom. cit.*, 143–6, 1 pl., 1 fig.). It is possible, by leaving small quantities of *Cylindrospermum* in a drop of water on a protected slide for a few days, to get the filaments to disentangle themselves, and then the characters of individual filaments can be readily determined. Quite commonly there is a heterocyst at each end of a filament; sometimes there is a spore adjacent to each heterocyst or to one of the heterocysts. The two ends of a filament are morphologically similar. Unless the filaments are disentangled, observation is liable to be faulty. A. G.

Cosmocladium.—J. HEIMANS ("Le genre *Cosmocladium* Bréb.," *tom. cit.*, 215–21, 1 pl.). This genus was founded by de Brébisson in 1856 to contain a desmid resembling a *Cosmarium*, but peculiar in that its cells remain united in colonies upon a branched gelatinous filament. De Brébisson's plant has never been found again. De Bary described another species in 1865. Heimans reviews the work of De Bary and subsequent authors, and the species which they have defined, and describes the observations which he has made on material collected in Holland, upon which a more detailed report will be published. A. G.

Zygnemales.—VIKTOR CZURDA ("Experimentelle Untersuchungen über die Sexualitätsverhältnisse der Zygnemalen," *Beih. z. Bot. Centralblatt*, 1930, 47, Erste Abteil., 15–68). An account of the experimental researches made by the author as to the conditions of sexuality of the Zygnemales, with a historical *résumé* of the taxonomy of the group. In *Spirogyra* he gives details of seven species which conjugate only ladder-wise, of three species which are able to conjugate ladder-wise and also laterally, and of one which forms azygotes. Four of these species of *Spirogyra* are new to science, and five are new combinations. In *Zygnema* he treats of one species which conjugates ladder-wise and is anisogamous, and of another, a new species, which conjugates ladder-wise but is isogamous. A. G.

Reduction Division in *Cladophora*.—E. MARION HIGGINS ("Reduction Division in a Species of *Cladophora*," *Ann. Bot.*, 1930, 44, 587–92, 1 pl.). Description of the nuclear history of both the sporangia and the vegetative parts of *Cladophora flavescens*. The summary of the investigation runs as follows. All stages in the division of the vegetative nuclei have been studied. The chromosome number is 24. No continuous spireme is found in the prophase stages. In the terminal parts of the filaments the phenomena of reduction are manifest, the diakinesis stage being especially marked. One homotype division, showing the reduced number of chromosomes (12), follows the heterotype division and precedes the differentiation of the spores. The plant is thus diploid, giving rise to haploid spores following a reduction division in the terminal sporangia. A. G.

Basicladia.—WM. E. HOFFMANN and JOSEPHINE E. TILDEN ("Basicladia, a New Genus of Cladophoraceæ," *Bot. Gaz.*, 1930, 89, 374–84, 22 figs.). An account of algæ found growing on the shells of turtles, and an investigation which led to the description of a new genus, *Basicladia*, characterised by the possession of a creeping rhizome (attached by holdfasts to the turtle shell) from which arise erect multicellular sparingly-branched filaments, the cells of which become shorter upwards, some being transformed into sporangia. There are two species, *B. crassa*, new to science, and *B. chelonum*, described by Collins as a *Chaetomorpha* in 1907. A. G.

Resting Organs of Cladophora.—B. VON CHOLNOKY ("Die Dauerorgane von *Cladophora glomerata*," *Zeitschr. für Botanik*, 1930, 22, 545–85, 42 figs.). *Cladophora glomerata* growing in the Lágymányoser See, by the Danube, in the summer of 1929, was found to be forming resting organs, owing to the warmth of the water. These resting organs are cells with thickened walls and a condensation of protoplasm. Similar resting cells are produced in cultures when not prevented by harmful influences. The normal germination of the resting cells takes the course of an elongation of the cell and the formation of several transverse septa; a lateral branching begins when the cell contents have almost resumed a vegetative appearance. The formation of resting cells can be artificially elicited or accelerated by poisons, such as cocain. If the dose is too strong, all but the completely developed resting cells perish, while the latter display a great resistance to the poison. A. G.

Spirogyra fluviatilis.—PIERRE DANGEARD ("Sur l'existence de deux variétés du *Spirogyra fluviatilis* Hilse et sur le cytoplasme de ces algues," *Le Botaniste*, 1930, 22, 15–32, 2 pls.). A discussion of two varieties of *Spirogyra fluviatilis* Hilse found at different levels in the lake of Annecy, and of the nature of their cytoplasm. Rod-like chondriosomes and minute granules are present, and in the vacuoles are small glittering particles displaying Brownian movements. There is the perinuclear protoplasm, the protoplasm lining the cell wall, and the subjacent protoplasmic network. The chlorophyll-containing spirals are not flat ribbons, but are channelled by offsets of the great central vacuole. A. G.

Oedogonium Fertilization.—EARLE AUGUSTUS SPESSARD ("Fertilization in a Living *Oedogonium*," *Bot. Gaz.*, 1930, 89, 385–93, 11 figs.). An account of the time element in the formation of sex organs in *Oedogonium*, their period of maturing, the length of life of sperms, the time consumed in the act of fertilization, and the destiny of unsuccessful sperms. It was found that sex organs are mature some 48 hours after they begin to form. The antheridia appear about a day later than the oogonia, insuring cross-fertilization between filaments. Sex-organ production reaches a maximum at intervals of about 15 days. Antheridia escape mostly between midnight and 4 a.m., and again between noon and 4 p.m. The unsuccessful sperm survives for 2 to 13 hours. Fertilization may occur within 2 minutes after discharge of the sperms. Passage of the sperm into the egg takes 30 seconds. The sperm is not to be considered a miniature zoospore. A. G.

Oedogonium.—GWEI-SZE MON-CHEN WU and JOSEPHINE E. TILDEN ("The Discovery of *Oedogonium princeps* (Hassall) Wittrock in North America," *New Phyt.*, 1930, 29, 141–7, 15 figs.). A review of the literature of *Oedogonium princeps*, first found by Hassall in 1842 near Notting Hill and at Cheshunt, and described and figured by him. Authentic material was examined by Wittrock (1874), and the plant is redescribed in Hirn's "Monographie" (1900). But the species had apparently not been found since Hassall's time till it was discovered in Glenwood Park, Minneapolis, Minnesota, in 1922 and in 1927. Male plants as well as female and sterile were secured. A. G.

Indo-Pacific Chlorophyceæ.—YUKIO YAMADA ("The Phyto-geographical Relation between the Chlorophyceæ of the Mariannes, Carolines and Marshall Islands and those of the Malay Archipelago, Australia and Japan," *Proc. Third Pan-Pacific Science Congress, Tokyo*, 1926, 964–6). Contains a table showing the distribution of 42 species of Chlorophyceæ in the Japanese regions, the Malay Archipelago, and the Australian regions, together with any wider distribution by which a given species is characterised. A. G.

Udotea.—YUKIO YAMADA ("Une nouvelle espèce d'*Udotea* du Pacifique : *Udotea Geppii* sp. nov.," *Rev. Algol.*, 1930, **5**, 139-42, 3 figs.). Description of a new species of *Udotea* from the Caroline Islands and the Friendly Islands. It is distinguished from *U. flabellum*, its nearest ally in structure, by the concentrically zonate markings of the fronds. A. G.

Caulerpa.—W. SCHWARTZ ("Studien über die 'Blattformen' von *Caulerpa prolifera*," *Flora*, 1930, N.F. **24**, 479-90, 3 figs.). *Caulerpa prolifera* bears two kinds of leaves (as the flat foliiform fronds may be called for sake of brevity); one type has a cordately incised apex, the other a rounded apex. The cordate type produces many more proliferations than the other does. The nature of the proliferations and their position on the mother-leaf are influenced by three conditions—the type of the mother-leaf, the age of the mother-leaf, the original position of the mother-leaf on the rhizome. There seems also to be a time factor to be considered, which manifests itself particularly towards the end of the vegetative season. A. G.

British Florideæ.—M. A. WESTBROOK ("Notes on the Distribution of Certain Marine Red Algae," *Journ. Bot.*, 1930, **68**, 257-64). Notes on the distribution of three noteworthy red algae which have been added to our flora within the last 30-40 years. (1) *Asparagopsis hamifera*, described by Hariot as a species of *Bonnemaisonia* from Japan in 1891, was found at Falmouth in 1896, and is now known from a number of places, including both sides of the English Channel and the west coasts of Scotland and Ireland. The reproduction is purely vegetative, by means of the persistent coiled branchlets. An allied species, *A. armata*, has been traced from Australasia to the Cape of Good Hope and to the Bay of Biscay. Both species appear to have been carried by ships. (2) *Trailliella intricata*, first collected at Studland in 1890 as a *Callithamnium*, and recognised as a distinct genus by Batters in 1896, is now known from both shores of the Channel, being abundant at Shanklin, from North and West Scotland, from Heligoland and Scandinavia. Its place of origin is obscure. (3) *Antithamnionella sarniensis*, first described from Guernsey by Miss Lyle (1922), is common on the French side of the Channel and at Plymouth. (4) In a further note the distribution of the two species of *Erythrocladia* is detailed. A. G.

Actinococcus and Sterrocolax.—B. D. GREGORY ("New Light on the so-called Parasitism of *Actinococcus aggregatus* Kütz. and *Sterrocolax decipiens* Schmitz," *Ann. Bot.*, 1930, **44**, 767-9). *Actinococcus aggregatus* is found on *Gymnogongrus Griffithsia*, and *Sterrocolax decipiens* on *Ahnfeltia plicata*. *Actinococcus* and *Sterrocolax* have been regarded as parasitic or epiphytic upon the two host plants mentioned. No reproductive organs have been recorded for these host plants, and as regards the two epiphytes, only the asexual phase is known. Now investigation shows that the pustules formed by these epiphytes are developed from inside the host; that there are rudimentary procarys and traces of a trichogyne in *Gymnogongrus* below the *Actinococcus* nemathecium; male organs have not been found. Similarly in *Ahnfeltia* changes were observed in the outer medullary cells which initiate the formation of the *Sterrocolax* nemathecium; no male organs are known. The *Sterrocolax* nemathecium produces monospores, while that of *Actinococcus* produces chains of tetraspores, usually with incomplete tetrad division—that is, monospores are formed. From all the evidence obtained, it appears that *Actinococcus* is the asexual biont of *Gymnogongrus Griffithsia*, and that *Sterrocolax* is probably the asexual biont of *Ahnfeltia plicata*, just as another *Actinococcus* has

been demonstrated by Rosenvinge to be the asexual generation of *Phyllophora Brodiaei*.
A. G.

Periphykon.—A. WEBER VAN BOSSE ("Sur un nouveau genre de Floridées," *Annales de Cryptogamie exotique*, 1929, 2, 255–61, 8 figs.). Description of a new alga, *Periphykon Beckeri*, epiphytic on *Laurencia ceylanica* on the south coast of Java. It forms a thin flat frond surrounding the host, and is dorsiventral in structure. It is three cells thick, consisting of a layer of central cells between a layer of dorsal and a layer of ventral pericentral cells. Rhizines issuing from the ventral layer are fused into an organ of attachment to the host. Reproductive organs (cystocarps) arise from the dorsal layer, being borne in succession on a cylindrical axis. The trichoblasts are caducous. The antheridia, foliiform in shape, and the stichidia are borne on very small shoots; the stichidia are cylindric and contain tetraspores spirally arranged. *Periphykon* resembles *Placophora* in habit, but approaches most nearly to *Pollexfenia*.
A. G.

Coral Reefs.—WILLIAM ALBERT SETCHELL ("Nullipore Reef Control and its Significance," *Proc. Fourth Pacific Science Congress, Java*, 1928, 265–86. Also "Coral Reefs as Zonation Plant Formations," *Science*, 1928, 68, no. 1754, 119–21). A discussion of the nature, natural history, growth and environment of coral reefs in the Pacific Ocean.
A. G.

Algæ and Iodine.—PIERRE DANGEARD ("Recherches sur les iodures, l'iodovolatilisation et les oxydases chez les Algues marines," *Le Botaniste*, 1930, 22, 33–73, 2 figs.). The author discusses the question of the presence of iodine in algæ, and gives a list of numerous algæ which he has tested with positive or negative results, including brown, red and green algæ and a diatom. Iodovolatilisation is a fact, but it is arrested by absence of oxygen. Bristol paper used in the experiments has been objected to as possibly containing iodides, but that suspicion is unjust—Bristol paper contains no iodides. The hypothesis of some authors, that some Floridæ contain oxydases which are set free after the death of the cells, and are capable of setting iodine free from iodides in an acid medium, has not been proved, and there does not appear to be any connection between the oxydase and the setting free of iodine.
A. G.

Canary Algæ.—F. BØRGESSEN ("Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophycæ. Part III. Ceramiales," *Det Kgl. Danske Videnskabernes Selskab., Biol. Medd.*, 9, 1, 1930, 1–159, 60 figs.). This, the concluding part of the description of the red algæ of the Canary Islands, treats of the Ceramiaceæ, Rhodomelaceæ and Delesseriaceæ, and contains over 90 species. Several matters of doubt are investigated and settled, and antheridial plants of several species are described and figured. *Vickersia canariensis* is but the tetrasporic plant of *V. baccata*. Accounts are given of the epiphytes *Janczewskia verruciformis* and *Ricardia Montagnei*. *Stichothamnion* is a small dorsiventral new genus of Rhodomelaceæ, which creeps on the thallus of *Ralfsia verrucosa*; it contains one new species, *St. cymatophilum*. *Cottoniella fusiformis* is a new species of West Indian affinity. The author finds that 44 p.c. of the Canarian red algæ are found on the American side of the Atlantic, while 76 p.c. occur on the European and African shores.
A. G.

Brazilian Algæ.—WM. RANDOLPH TAYLOR ("Algæ collected by the Hassler, Albatross, and Schmitt Expeditions. I. Marine Algæ from Brazil," *Amer. Journ. Bot.*, 1930, 17, 627–34, 1 pl., 1 fig.). A preliminary account of some algæ collected by the Hassler Expedition, 1871–2, the Albatross Expedition, 1887–8, and by

Dr. Waldo L. Schmitt, 1925-7. The algæ of the Gulf Stream and of the coast of Brazil are here enumerated. They include 24 Chlorophyceæ, 21 Phæophyceæ, and 43 Rhodophyceæ. The list adds about 30 species to the Brazilian flora. A. G.

Algæ from Sao Paulo.—WM. RANDOLPH TAYLOR ("Note on Marine Algæ from Sao Paulo, Brazil," *tom. cit.*, 635, fig.). A list of 11 algæ from Sao Paulo, collected by L. B. Smith, which contain 3 more additions to the Brazilian flora. A. G.

Bombay Algæ.—F. BØRGESSEN ("Some Indian Green and Brown Algæ, especially from the Shores of the Presidency of Bombay," *Journ. Ind. Bot. Soc.*, 1930, 9, 151-74, 2 pls., 10 figs.). A preliminary account of some green and brown algæ collected on the coast of Bombay during the winter of 1927-8. The green algæ consist of species of *Dictyosphaeria*, *Boodlea*, *Willeella* (a new genus of Anadyomenaceæ), *Acetabularia*, *Codium*, *Udotea*, *Halimeda*, *Pseudobryopsis*, and the brown contain *Ectocarpus*, *Rosenvingea*, *Zonaria*, *Padina*, *Dictyopteris*. Two new species are described, and many critical notes are embodied in the paper. A. G.

Japanese Algæ.—YUKIO YAMADA ("Notes on Some Japanese Algæ—I," *Journ. Faculty of Science, Hokkaido Imp. Univ.*, 1930, ser. v, 1, 27-36, 5 pls., 2 figs.). Descriptions and figures of six new species of Japanese algæ, belonging to the genera *Callophyllis*, *Acrosorium* (2), *Pseudophycodrys*, *Heteronema*, *Hypoglossum*, also revisions of four determinations which had been accepted in the Japanese flora, but were found to be incorrect by the author when visiting the herbaria of Europe. A. G.

Fungi.

Roumanian Peronosporæ.—FR. SĂVULESCU and T. RAYES ("Contribution à la connaissance des Peronosporacées de Roumanie," *Ann. Mycol.*, 1930, 28, 297-320, 15 text-figs.). The authors present this first contribution to the knowledge of the Peronosporæ—*Pythium*, *Cystopus*, *Sclerospora*, *Plasmopara*, *Pseudoperonospora*, and finally *Peronospora* with two species of *Bremia*. The *Peronosporæ* are well represented, the other genera rather poorly. There are 97 species in the list. The authors are preparing a *Herbarium Mycologicum Romanicum* which will appear shortly. Several species of *Peronospora* are new to science, and these are carefully described and figured. The host plant and locality are given in every instance. A. L. S.

Study of Glaziella.—K. B. BOEDIJN ("Die Gattung *Glaziella* Berk.," *Bull. Jard. Bot. Buitenzorg*, 1930, 11, 57-66). The fungus first described by Berkeley (1879), from Brazil, has been recently collected in Dutch East India, and Boedijn has carefully examined and described it. The fruiting body is of considerable size, the largest from Borneo 50 mm. long, 25 mm. wide, and 30 mm. high. It grows on the soil surface. The nature of the spores has been a difficulty; they measure, when round, $288-432\mu$, and if ellipsoid up to $340\mu \times 297\mu$. They are solitary, and borne at the tips of hyphæ in the tissue of the fungus. The author describes them as chlamydospores, and, on account of the non-septate mycelium, considers the fungus as akin to Phycomycetes. It has been generally associated with Endogonaceæ. A. L. S.

New Mucorini.—A. LENDNER ("Détermination de Mucorinées," *Bull. Soc. Bot. Genève*, 1929-30, 21, 256-63, 4 text-figs.). The author gives an account of two consignments of Mucorini recently received. One, from India, included a new species, *Mucor indicus*; the other, sent from Kew by S. F. Ashby, contained

four species, one of which was new to science, and had been isolated by R. H. Bunting, hence the name given to it, *Mucor Buntingii*. It is interesting in that it includes characters similar to those of *Absidia* and also of *Rhizopus*. The sporangia have a large columella and minute globose spores. A. L. S.

Distribution of Mould Fungi.—ADALBERT BLOCHWITZ ("Standorte und Geographische Verbreitung der Schimmelpilze," *Ann. Mycol.*, 1930, 28, 241–68). The author takes first the Aspergillæ and gives an account of the many different kinds of substrata on which the genera and species may be found. He discusses them from the substratum aspect under three divisions—the hygrophilæ, the mesophilæ and the hygrophobæ. He then considers the geographical distribution as well as the means of dissemination, also the different life-stages that add to their power of spreading; in these latter are included those that form conidia along with sclerotia, or perithecia in more or less abundance. The *Mucorini* have also been studied, and in that group world-wide species are more frequent. A list is given of the smaller genera and their occurrence in different countries where the somewhat rare species have been discovered. A. L. S.

Apothecial Development.—S. G. JONES ("A Study of Apothecial Development in the Leaf-Spot Disease of Red Clover," *Trans. Roy. Soc., Edin.*, 1930, 56, 507–19, 9 text-figs.). The fungus *Pseudopeziza Trifolii* appears as purplish black spots on the leaves of red clover. The apothecia are developed on the spots. The author had noted that the spots tended to grow in clusters. He found that they arose from ascogonial coils within certain substomatal cavities, and were initiated by ascogonial coils. These were vegetative in character, and by branching extended to other substomatal cavities and gave rise to fresh apothecia. The ascogonial coil is itself abortive, but neighbouring cells—possibly owing to stimulation—became multinucleate, termed by the author "primordial cells." Development proceeds in an apogamous manner, and from the primordial cells arise the ascogenous hyphæ. The terminal cell of a primordial group is an elongated hypha which passes out at a stomatal pore and is probably respiratory. Apothecium initials may rise from primordial cells of other initials without the intervention of the abortive ascogonial coil, provided always that the cells are multinucleate, that they are situated below a substomatal cavity, and are accompanied by a respiratory hypha. Details are given as to the further development of the apothecium: nuclear fusion takes place in the ascus; the first nuclear division shows four minute chromosomes. A. L. S.

Sexuality in the Ascomycetes.—B. O. DODGE ("Material for Demonstrating Sexuality in the Ascomycetes," *Torreya*, 1930, 30, 35–9, 1 pl., 3 text-figs.). The author stresses the necessity for the student of botany and biology to be able to recognise types of fungal parasites when encountered in the field, and therefore the need of exact education. He recommends for class demonstration the culture of *Rhizopus* and *Phycomyces*, and in Ascomycetes, *Neurospora sitophila*, the latter distinguished and easily recognised by its orange-coloured asexual conidiophores. The ease with which it is grown in cultures—two strains producing abundant ascocarps where the different mycelia meet—renders it an attractive fungus for the classroom. A. L. S.

New Species of Plenodomus.—JOHN DEARNESS and G. B. SANFORD (*Ann. Mycol.*, 1930, 28, 324–5). The authors made a study in Canada of necrotic brown lesions on the roots of *Melilotus*, *Medicago*, and *Trifolium*, with which were associated the pycnidia of a fungus. They succeeded in determining the

connection, the fungus being the causal agent of the necrosis. They have recognised the fungus as *Plenodomus Melliloti* n. sp., a full description and diagnosis of which are given. A. L. S.

Differential Growth of Phytophthora.—LEON H. LEONIAN ("Differential Growth of Phytophthoras under the Action of Malachite Green," *Amer. Journ. Bot.*, 1930, **17**, 671-7). The author has given his experiences in differentiating species and strains of *Phytophthora* by their reaction in a hindered growth to Malachite Green. He tested a number of cultures with solutions of different strength—1, 2, 4, 8 to 16 million parts of the nutrient solution to 1 part of the dye. Tables of results are given, and finally the proved difference between the *P. cactorum* group and that of *P. omnivora*. For the former 1 part of the dye to 4 million parts of the nutrient solution was effective, while in the *P. omnivora* group it was higher and able to resist more of the dye. Leonian concludes that the dye may serve to define groups of closely-related species. A. L. S.

Cup-Fungi.—FRED J. SEAVER ("Photographs and Descriptions of Cup-Fungi. XIII. Subhypogeous Forms," *Mycologia*, 1930, **22**, 163-218, 2 pls.). Seaver has published plates and descriptions of species of *Sepultaria* and of *Sarcosphaera*. The early stages of development take place under the soil or sand. Frequently only the margin of the fruiting body is visible. * A. L. S.

A New Truffle.—W. W. DIEHL and E. B. LAMBERT ("A New Truffle in Beds of Cultivated Mushrooms," *Mycologia*, 1930, **22**, 223-6, 1 pl.). The new fungus *Pseudobalsamii microspora* sp. nov. was found as a pest in mushroom beds from several localities. The first appearance is a cottony web of mycelium, from which develop the ascocarps. It has been found that it is introduced in the compost, and acts as a fungous weed rather than a parasite, though it tends to reduce the yield of mushrooms. A. L. S.

Botrytis Forms.—H. KLEBAHN ("Zur Kenntniss einiger *Botrytis*-Formen von Typus der *Botrytis cinerea*," *Zeitschr. für Bot. Festschrift zum 70. Geburtstage von Friedrich Oltmans*, 1930, **23**, 251-72, 4 text-figs.). The fungus described was found on Douglas firs and proved to be an active parasite. The author has cultured it and has compared the growth and form with that of other species; he has also given the results of many different infection experiments. He has suggested that many of the forms examined might be included in *Botrytis cinerea*, regarding that as a collective species, but he is unable to give a decisive judgment. A. L. S.

New Acrostalagmus.—A. SARTORY, R. SARTORY, and J. MEYER ("Etude d'un *Acrostalagmus* nouveau: *Acrostalagmus cinnibarinus*, variété *minimus*," *Ann. Mycol.*, 1930, **28**, 269-72, 1 pl.). The authors give a description of the new variety distinguished from the species by the smaller size. Cultures of the fungus were made on a number of media, the most successful on "Roulin glucosé," the characteristic red colour appearing on the eighth day along with conidial formation. A. L. S.

Study of Cercospora.—WILHELM GERHARD SOLHEIM ("Morphological Studies of the Genus *Cercospora*," *Illinois Biol. Monographs*, 1929, **12**, 1-84, 4 pls.). *Cercospora* is a genus of fungi parasitic on the leaves of herbs, shrubs, and trees. It includes many species, and was established by Fresenius in 1863. Solheim has made a study of the genus—the morphology, the life-history, the taxonomic affinities, finally of the species: these he has listed and described under 21 sections—the first 11 characterised by internal mycelium only, the remaining 10 by both internal and external mycelium. Other characters are the branching of the conidio-

phores and, above all, the forms of the conidia, which are very distinctive, and their colour hyaline to dark brown. In three species a perfect *Mycosphærella* perithecial stage has been proved. These are *Cercospora cerasella* = *Mycosphærella cerasella*, *C. microsora* = *M. millegrana*, and *C. Bolleana* = *Mycosphærella Bolleana*. No others have been conclusively proved. Infection takes place by the germinating hyphæ entering the leaf usually by the stoma, but in some species by penetrating the cuticle. A. L. S.

Cytology of Gymnosporangium.—EDITH STEVENS ("Cytological Features of the Life-History of *Gymnosporangium Juniperi-virginianæ*," *Bot. Gaz.*, 1930, 89, 394-400, 2 pls.). The research was made on the "cedar-apples" of *Juniperus virginiana* collected at weekly intervals during March, April, and May. Stages in the development of pycnidia and æcidia were obtained by infecting apple seedlings. The methods of inoculation and preparation are described. The cytological study concerns the teleutospores. The first stage was the formation of three cells from the end of a mycelial hypha, the middle or basal cell sends up a projection (through the upper cell) which divides into the stalk cell and teleutospore mother-cell, the nuclei of this cell divide, giving rise to a four-nucleate cell, followed by cell-division, each daughter-cell with two nuclei, which fuse later. Further development follows—each mature uninucleate cell of the teleutospore sends out a basidium where reduction in the nucleus takes place. The haploid number of chromosomes is two and the diploid four. A. L. S.

New Puccinia Species.—P. DIETEL ("Über einige neue *Puccinia*-Arten aus Asien," *Ann. Mycol.*, 1930, 28, 272-7). The first members of the series from Cappadocia and other localities were found on leaves and stalks of *Johrenia fungosa*; æcidia and teleutospores were present. Two species from Japan with teleutospores only are also described. A. L. S.

Rust-Fungi New to Japan.—NACHIDE HIRALSUKA ("Über einige interessante oder für Japan neue Rostpilze," *tom. cit.*, 278-80). The author lists 16 species new to Japan, two species of *Phragmidium* being new to science—one on *Geum* sp., the other on *Rubus* sp. Several species of *Puccinia* were found on new host plants. A. L. S.

Study of Uromyces Scillarum.—TRUDE GRAFLINGER ("Zur Kenntniss der Kleinarten von *Uromyces Scillarum*," *tom. cit.*, 321-3). Under the designation "small species" the author has described a series of forms of *Uromyces Scillarum* that grew on closely-allied *Scillæ*. The differences were mainly in the spore sizes, and careful measurements of these are published. A. L. S.

Study of Ustilago Spores.—G. VERPLANCKE ("Étude biométrique de quelques formes d'*Ustilago Zeæ* (Beck.) Unger.," *Bull. Soc. Roy. Bot. Belg.*, 1930, 62, 137-64, 8 pls.). The study was undertaken to observe if in cultures there was any connection between saltations and spore-form. The spores of the fungus, *Ustilago Zeæ* were cultured on four different media. A detailed account is given, in a series of tables, of the sizes and forms of the spores observed in the different cultures, and they are also figured in the plates. In the final discussion he comments on the great variability of the spores and of the cultures in every character and without correlation between the cultures and these spore-characters. The experience of other workers dealing with fungus cultures is cited: great variation in spore-forms. Verplancke also notes that he obtained no fusions either between the spores or the filaments—such fusions he considers might possibly have explained the differences noted. A. L. S.

Basidiomycete Culture.—S. R. BOSE ("Artificial Culture of *Ganoderma lucidus* Leyss from Spore to Spore," *Bot. Gaz.*, 1929, **87**, 605-7, 1 text-fig.). Bose describes the methods he used to secure the culture of *Ganoderma* spores. The best results were obtained with malt extract agar. The spores germinated and growth was slow for some time, but cultures were maintained and spores developed which were transferred to fresh media. Finally a transfer was made to sterilised wood, and a minute fructification with typical spores was secured.

A. L. S.

Resupinate Hydnaceæ.—K. CEJP ("Neue Beiträge zur Kenntniss der resupinaten Arten der Hydnaceen in Böhmen," *Ann. Mycol.*, 1930, **28**, 287-90). Cejp has listed a considerable number of these resupinates, all of them additions to the Bohemian flora: there are 4 species of *Grandinia* and 14 species of *Odontia*. Eight genera in all are represented. Habitats and localities are given, with occasional biologic notes.

A. L. S.

Nuclei of Basidiomycetes.—RENÉ VANDENDRIES ("La bipolarité sexuelle chez *Coprinus disseminatus* Pers.," *Bull. Soc. Roy. Bot. Belg.*, 1930, **62**, 133-6). The author collected the spores shed from 15 specimens taken from different localities. He obtained 24 monosperm cultures and crossed them two by two: the species was thus proved to be bipolar, and 16 individuals of one sex and 8 of another were identified. On tables he has represented the crossings and the growth results. The haploid cultures grew vigorously, conjugation was rapid, and a rich culture of diploid mycelium with clamp connections was obtained. Vandendries also notes that sexual bipolarity in Basidiomycetes is less frequent than tetrapolarity.

A. L. S.

New Chanterelle.—ELIZABETH EATON MORSE ("A New Chanterelle in California," *Mycologia*, 1930, **22**, 219-20, 2 pls.). A full description is given of *Cantharellus Bonarii* sp. nov., which developed in gregarious clumps in deep humus under pine and fir. The bases of the plants were mostly fused. The new fungus resembles somewhat *Cantharellus floccosus*.

A. L. S.

Trametes as a Parasite.—ERNEST C. SMITH ("Trametes hispida, a Destructive Parasite in Apple Orchards," *tom. cit.*, 221-2, 1 pl.). This fungus has been regarded as a saprophyte of dead willows or poplars. It has been proved by Smith to be a fatal parasite of orchard trees, later becoming saprophytic on the dead wood.

A. L. S.

Panama Fungi.—F. L. STEVENS ("Parasitic Fungi from Panama," *Ann. Mycol.*, 1930, **28**, 281-6, 6 text-figs.). The fungi listed belong chiefly to the Phycmycetes and the Ascomycetes, species of *Albugo* with their hosts belonging to the first-named group; to the latter numerous genera and species of Pyrenomycetes, including two species of *Phyllachora* new to science. A rare Gasteromycete, *Stabellomyces cinctus*, was also found.

A. L. S.

Fungus Flora of Silesia and Moravia.—JOHANN HRUBY ("Beiträge zur Pilzflora Mährens und Schlesiens," *Hedwigia*, 1930, **70**, 234-352, 6 pls.). This work gives lists of fungi collected largely in the Carpathian mountains. Hruby deals exclusively with the Eubasidii, comprising eight Orders, Plectobasidiineæ, such as *Scleroderma*, *Sphaerobolus*, etc., being the last in the series. The place and the date of collection are carefully recorded, as well as the collector. A number of Agaricaceæ are described as new to science.

A. L. S.

New British Fungi.—W. B. GROVE ("New or Noteworthy Fungi," *Journ. Bot.*, 1930, **68**, 270-5 and 293-7). The species described belong to the Cœlomycetes, mostly species of *Phomopsis* (Sphæropsidæ). Several of them are new to science, and the descriptions are accompanied by biological notes. A second instalment also deals with *Phomopsis*. Several species new to science are described. Grove notes that a *Phomopsis* fungus is easy to recognise, but species are difficult to diagnose, and he considers that with more knowledge there will be a linking up of species. He has found, however, that species almost alike have widely different ascigerous stages. He draws attention to the large number of forms that occurred in the neighbourhood of Polperro in Cornwall. A. L. S.

Fungi of the Asturias.—P. LUIS M. UNAMUNO ("Nueva aportación al estudio de la Flora Micologica del Concejo de Llanes (Asturias)," *Bol. Real Soc. Esp. Hist. Nat.*, 1930, **30**, 179-87). Unamuno describes the region of Llanes as unusually rich in fungi. The list he gives of 45 fungi includes a few Hymeniales and Gasterales, but most of the specimens are parasites or saprophytes on vegetation living or dead, and belong to the Uredineæ, the Ascomycetæ, and, above all, to the Deuteromycetæ. In the latter group he has discovered and described many species new to science; he adds biological notes to his account of the plants. A. L. S.

Mycological Notes.—M. BEELI ("Notes mycologiques. Champignons nouveaux pour la flore belge—II," *Bull. Soc. Roy. Bot. Belg.*, 1930, **62**, 127-32, 1 pl.). Beeli lists fungi new to the Belgian flora that were collected in 1924 to 1929. There are included three new species—*Peziza luteomarginata* on burnt soil, *Cladesiella* sp. on dead vegetation, and *Cortinarius radicans* on soil. Most of the species enumerated belong to the larger Basidiomycetes. A. L. S.

Fungus Physiology and Taxonomy.—ELAINE M. YOUNG ("Physiological Studies in Relation to the Taxonomy of *Monascus* spp.," *Trans. Wisconsin Acad. Sci. Arts & Letters*, 1930, **25**, 227-44, 2 pls.). The physiological differences between species of *Monascus* have been worked out by the author and have been found sufficient to determine the specific value of these, especially of the silage and starch moulds. Of the latter, *Monascus ruber* is the principal species, and strains from South Africa, from Australia, and from Nebraska were cultured and compared. The differences that arose in the cultures are described. It was found that some of the species reported are merely strains, but the author finds that there are five clearly defined species in the genus—*Monascus purpureus*, *M. Barkeri*, *M. Olei*, *M. mucoroides* and *M. ruber*. They all grow on organic substances such as silage, starch, rice, skins, pickles, etc. A. L. S.

Cellulose-Decomposing Fungi.—A. GEOFFREY NORMAN ("The Biological Decomposition of Plant Materials. Part III. Physiological Studies on Some Cellulose-Decomposing Fungi," *Ann. Appl. Biol.*, 1930, **17**, 575-613, 3 pls.). The investigation was directed towards the kinds of fungi that brought about the decomposition of cellulose in the soil. Certain fungi were isolated that attacked cellulose in straws, but made only meagre growth on cellulose-agar plates. Attention was given to the availability of nitrogenous compounds as growth factors, including casein, asparagine, peptone, etc. Peptone was the most generally utilisable form, and was used in the cultures. Tables of results in culture of a series of fungi are given, and to these are added the descriptions of variations in the cultures. The question of thermogenesis entered largely into the study; the isolated fungi all had a high optimum temperature. Finally the effect of a mixed fungus-flora is discussed: there was proved a co-operative association, by which decomposition was rapidly and effectively carried out. A. L. S.

Mushroom Culture.—ILLO HEIN ("Soy-Bean Stover Compost for Mushroom Culture," *Mycologia*, 1930, 22, 227-31). The use of the substance termed "Stover Compost" has been experimented with as a substitute for horse manure and straw composts. The productivity of the mushrooms on the beds was below that on the more usual composts, but possibilities of success are indicated.

A. L. S.

American Mycology.—L. O. OVERHOLTS ("Mycological Notes for 1928-1929," *tom. cit.*, 232-46, 4 pls.). Notes and descriptions of species belonging to different families and genera. The question for each as to parasitism or saprophytism is discussed, and in many cases the diagnoses are rewritten. Several new species are included in the paper.

A. L. S.

Medical Mycology.—ALDO CASTELLANI ("Fungal Diseases of the Tonsils (Tonsillomycoses)," *Journ. Trop. Medicine & Hygiene*, 1930, 1-16, 31 text-figs.). Castellani gives an account of many fungi that attack the human body, more especially filamentous fungi belonging to the genera *Monilia*, *Nocardia*, *Oidium*, etc., all of which may cause Tonsillomycosis (disease of the tonsils), and most of them with numerous species. Cases are described in which the fungi occurred and caused serious trouble in tropical countries. Castellani, in describing them, has divided the fungi into two groups—those that are chronic and those that are acute. In some of the latter group there is great resemblance of the growths to diphtheria. Full descriptions of the fungi are given and of the diseases due to their attack.

A. L. S.

Cotton Root-Rot.—J. J. TAUBENHAUS and WALTER N. EZEKIEL ("Studies on the Overwintering of *Phymatotrichum* Root-Rot," *Phytopathology*, 1930, 20, 761-85, 4 text-figs.). The object of this study was to determine the means by which the fungus causing the root-rot was able to persist during the winter. It had already been found that the fungus spread from plant to plant during the growing season along the roots. It has now been determined that living infected roots may persist in the soil during the winter, and that the fungus in the form of sclerotia on dormant strands is able to survive and to continue the attack on other roots. It was found also that *Phymatotrichum omnivorum*, the fungus in question, continued viable in infected roots only so long as these roots were to some extent alive. Special attention was paid to the particular stage of decay at which the fungus lost viability. The sclerotial stage, however, can continue its existence on other roots than those of the cotton plant. Many experiments were carried out, and the various growths of the sclerotia are described. Suggested associations with the higher fungi (such as *Hydnum*, etc.) are discussed, but nothing definite has been discovered.

A. L. S.

Disease of Apple Seedlings.—J. A. MCCLINTOCK ("The Longevity of *Phyllosticta solitaria* E. and E. on Apple Seedlings held in Cold Storage," *tom. cit.*, 841-8, 3 text-figs.). Apple seedlings may be kept in cold storage for a considerable time. Two cases are known where surplus lots were held thus throughout an entire growing season, and were used for planting out the following year. The present study deals with the liability of seedlings to blotch disease. The observations were made on seedlings that had been conveyed into Tennessee from mid-western nurseries. It was found that the fungus was practically dormant in storage conditions, but when the seedlings were planted out, the fungus *Phyllosticta solitaria* developed and formed blotch-cankers. The writer stresses the importance of destroying all affected seedlings.

A. L. S.

Maple Leaf Disease.—PAUL R. BOWEN ("A Maple Leaf Disease Caused by *Cristulariella deprædans*," *Bull.* 318, *Conn. Agric. Exp. Station, New Haven*, 1930, 625-47, 8 pls.). The disease first noted and described by M. C. Cooke as *Polyactis deprædans* was subsequently studied by Van Höhnelt and placed in *Cristulariella*. It attacks sugar maple, forming small greyish spots on the surface of the leaves—the fruiting heads of the fungus not unlike those of a *Botrytis*. The affected leaves wilt and fall from the trees, thus causing premature defoliation. Cultures of the fungus were made and inoculation experiments were carried out. It was found that warm temperature and high humidity were favourable to the spread of the disease.

A. L. S.

Physiology of Parasitism.—R. SAHAI VASUDEVA ("Studies in the Physiology of Parasitism. XII. On the Effect of One Organism in Reducing the Parasitic Activity of Another," *Ann. Bot.*, 1930, 44, 557-64). The writer found that in cultures of *Monilia fructigena* and *Botrytis Allii* on apple tissues the activity of the former was reduced if the *Botrytis* was introduced. The conclusion is that some staling process was causing the interference with growth. A number of experiments with different fungi are recorded.

A. L. S.

Studies in Fungus Culture.—K. R. MOHENDRA and M. MITRA ("On the Cultural Behaviour of *Sphæropsis malorum*," *tom. cit.*, 541-55). It had been noted that spores from a pycnidium of *Sphæropsis malorum* in culture gave rise to colonies varying in colour from black to white. These colonies were transferred, and the production of black colonies was, in time, entirely replaced by the white form. Suggestions and explanations are given as to the meaning of the phenomena.

A. L. S.

Study of *Typhula graminum*.—HEIZI TASUGI ("On the Pathogenicity of *Typhula graminum* Karsten," *Journ. Imp. Agric. Exp. Station, Tokio, Japan*, 1930, 183-98, 2 pls., Japanese with English résumé). This is a second paper on the fungus that causes "snow-rot" disease, and is devoted to a description of inoculation experiments and the result on the host plants. Cold weather is particularly favourable to the progress of the disease, which was formerly supposed to be due to snow or extreme cold and moisture, though these conditions certainly favour the attack. In early stages the affected roots become brown to blackish-brown. In warm dry weather the plant may recover, producing new vigorous rootlets. Strains of the fungus were collected from various cereals, but no significant difference was indicated between them.

A. L. S.

Study of *Thielavia*.—CHESTER W. SIMMONS ("Coniothyrium terricola proves to be a Species of *Thielavia*," *Bull. Torrey Bot. Club*, 1930, 57, 123-6, 1 pl., 1 text-fig.). The fungus in question had been isolated from the soil and determined as a *Coniothyrium*, later recognised as a species associated with decayed roots of strawberry. Another species, *Thielavia basicola*, had been found to cause serious root-rots of tobacco and many other plants. The *Coniothyrium* was again tested in cultures and proved to be *Thielavia terricola* comb. nov. The perithecia and dark-coloured spores were freely formed in the cultures on corn meal agar.

A. L. S.

New Nematospores.—JEHANGIR FARDUNJI DASTAR and JIWAN SINGH ("A New *Nematospora* on Cotton Bolls in the Central Provinces (India)," *Ann. Mycol.*, 1930, 28, 291-6, 22 text-figs.). This is the first record of *Nematospora* on cotton in India. The diseased bolls were collected at Nagpur; they were brown in colour, and on examination were found to be infected by *Nematospora*, both

yeast cells and asci being present. The fungus was carefully studied by means of artificial cultures and by inoculations ; full descriptions of these are given. The differences between the new species, *Nematospora Nagpuri*, and previously recorded species on cotton are described, and the reasons are given for considering it a new species.

A. L. S.

Leaf Disease of Cotton.—R. H. STOUGHTON ("The Influence of Environmental Conditions on the Development of the Angular Leaf-Spot Disease of Cotton. II. The Influence of Soil Temperature on Primary and Secondary Infection of Seedlings," *Ann. Appl. Biol.*, 1930, 17, 493-503). This disease of cotton is caused by *Bacterium malvacearum*. The object of the research was to examine the causes—soil, temperature, etc.—that influenced the attack and spread of the disease. Special attention was given to the carrying of the disease by the seeds. It was found that seeds from infected plants might carry the organism on the outside, and these might give rise to infected plants ; if the seeds were cleansed, the seedlings were healthy. Experiments were also made of secondary infection—spraying the plants with water carrying the bacterium. The amount of infection was variable. In cases of primary infection there was a decrease at temperatures above 30° C. Soil temperature had no effect on secondary infection. It was also proved that diseased seedlings might grow out free from disease if no further inoculation took place.

A. L. S.

Fusarium on Rye.—ULRICH BALZER ("Untersuchungen über die Anfälligkeit des Roggens für Fusariosen," *Phytopatholog. Zeitsch.*, 1930, 2, 377-441, 11 text-figs.). The writer describes the great cultivation of rye in Germany, and the liability to be attacked by *Fusarium*, with an account of the ravages of the fungus. He has made a long series of infection experiments with *Fusarium nivale* and *F. culmorum*, and gives descriptions of the parts of the plant infected. Another object of the research was to determine the kinds of rye that were most liable to disease. Balzer found, as a result of his researches, that *Fusarium culmorum* was the most active parasite ; all the different ryes were infected easily with that species. *F. nivale*, on the contrary, was a weak parasite. The quality of the soil was also found to be an important factor in inducing disease. In the summary the author dwells more particularly on the qualities of the fungus as a disease agent.

A. L. S.

Disease of Conifers.—S. M. ZELLER and L. N. GOODING ("Some Species of *Atropeltis* and *Scleroderris* on Conifers in the Pacific North-West," *Phytopathology*, 1930, 30, 555-67, 1 pl., 2 text-figs.). While studying canker-like diseases of conifers in Western America and British Columbia, the writers found a new type of fungus seriously affecting *Pinus monticola* and *P. contorta*, and nearly related to *Scleroderris* spp. Twigs and branches and also trunks of trees up to 4 in. diameter have been found to be affected, and when the trunk is girdled, the tree dies. The occurrence of infection, both of time and position on the host, has been studied and fully discussed. The wood attacked shows a bluish-black stain. The authors have placed the fungus in a new genus and species, *Atropeltis pinicola*. It kills the cortex in long strips. The authors have also studied a canker of *Abies grandis* and *A. pinicola* caused by *Scleroderris abieticola* sp. nov. They have also recognised *Scleroderris Treleasei* Sacc. as a species of *Atropeltis*—*A. Treleasei* Zell. and Good. comb. nov.

A. L. S.

Rhizoctonia Disease.—PAUL E. TILFORD ("A *Rhizoctonia* Disease of Sweet Alyssum," *tom. cit.*, 587-90, 2 text-figs.). The disease occurred in a garden in Ohio, and started in the lower portion of the plants, where the leaves and stems

lay on the ground. In a short time the leaves rotted and shrivelled up. No lesions were noted on the main stem below the level of the soil. Cultures were made of the fungus, and the disease was traced to an attack of *Rhizoctonia*. It varied considerably from *R. Solani*, but was finally referred to a strain of that species. Spraying the plant with Bordeaux mixture is recommended. A. L. S.

Phyllosticta on Chick-Pea.—RODERICK SPRAGUE ("Notes on *Phyllosticta Rabiei* on Chick-Pea," *tom. cit.*, 591-3). The writer has proved, by cultures and artificial inoculation, that the fungus on chick-pea is distinct from any *Ascochyta* on leguminous plants. A full discussion of the matter is given, with comparisons of the various allied organisms. A. L. S.

Chestnut Disease.—G. VERPLANCKE ("Une maladie intéressante du châtaignier," *Bull. Soc. Roy. Bot. Belg.*, 1930, **62**, 105-7, 1 pl.). After examination of the trees affected, the author came to the conclusion that the disease was not due to the well-known *Endothia parasitica*, which has been so destructive in America, but to the Pyrenomycete *Valsa ambiens*, and more especially to the stage *Cytospora ambiens*. It grows beneath the bark, and gives rise to cankers. The bark may be completely destroyed in older trees. The disease has been observed in several localities. A. L. S.

Myxobacteria.—JAN BADIEN ("Z. Cytologii Miksobakteryi zur Zytologie der Myxobakterien"), *Acta Soc. Bot. Pol.*, 1930, **7**, 55-71, 1 pl., 10 text-figs., Polish with German résumé). The author finds that there are no true nuclei in the Myxobacteria, but there is chromosome formation in the cell, an elongate structure, thicker at each end, which divides lengthwise by splitting. These follow various changes from the form of the "rods" to rounded bodies, followed by cell-division. Before the cells become spore-cells there is again a splitting division; later the two bodies unite and form a bivalent (diploid) chromatin "rod." Details are given as to these various divisions and their significance. A. L. S.

Lichens.

American Cladoniæ.—ALEXANDER W. EVANS ("The Cladoniæ of Connecticut," *Trans. Connect. Acad. Arts & Sci.*, 1930, **30**, 357-510). In this paper Evans gives a history of *Cladonia* study in the State of Connecticut, a general account of these symbiotic plants, etc. He then describes the genus morphologically. There follows a systematic account with the subgenera, *Cladina*, *Pynothelia*, and *Cenomyce*. Evans has provided useful keys to every section of his work and a full index. The descriptions are full, and he gives notes on field conditions and on variability. A. L. S.

Lichens of Suffolk.—A. MAYFIELD ("The Hepatics, Mosses and Lichens of Suffolk," *Journ. Ipswich & District Nat. Hist. Soc.*, 1930, **29**-52). The lichens listed are mainly corticolous, as in Suffolk there is an absence of rocks. A number are, however, recorded from walls and old buildings. Most of the groups are well represented, especially Caliciaceæ and Collemaeæ. A. L. S.

Lichens of Czechoslovakia.—M. SERVIT ("Flechten aus der Cechoslovakiei," *Vestniku Kral. Čes. Spol. Nauk*, 1929, **2**, 1-50, 3 pls., German with French résumé). The paper, giving an account of lichens in the neighbourhood of Prague, opens with a description of the territory examined, with a detailed account of special localities. Servit enumerates 41 of these, with their characteristics, many of them with different kinds of rock or of forest, and with different conditions of

light, moisture, etc. There are listed representatives of most European groups, though some with very few species. The large majority are saxicolous. The author notes as of especial interest *Sarcopyrenia gibba*, new to Bohemia, with several other crustaceous species also new to the district. He describes two species and several varieties new to science. A. L. S.

Lichens of Porto Rico.—JOYCE HEDRICK ("New Species of Lichens from Porto Rico—IV," *Mycologia*, 1930, 22, 247-55). The paper, which includes 25 new species of microlichens, is the fourth in a series of lichens collected by Bruce Fink, and most of them determined by him before his death. Two new genera are included—*Gymnographoidea* (Arthoniaceæ) and *Leucogymnospora* (Graphidaceæ). The algal "host" is indicated in each case. A. L. S.

Lichens of the Jura.—CH. MEYLAN ("Troisième contribution à la connaissance des lichens du Jura," *Bull. Soc. Vaud Sci. Nat.*, 1930, 57, 213-18). Meylan has added extensively to his previous lists. He notes the great abundance of lichens in the Haut-Jura. Some of the species are new to Switzerland; several varieties and forms are new to science. A. L. S.

Russian Lichens.—V. P. SAVICZ ("Lichenotheca Rossica," *Bull. Jard. Bot. Princ. U.R.S.S., Leningrad*, 1930, 29, 193-6). Savicz gives here a continuation of his Russian Lichens, Nos. 21-30. The list includes boreal species such as *Gyrophora Muhlenbergii* and *Cetraria Richardsonii*, chiefly known as North American. There is one species new to science, *Placodium Tominii*, now fully described. A. L. S.

Acharian Peltigeræ.—V. GYELNIK ("Revisio peltigerarum herbarii achariani," *Magyar Bot. Lapok*, 1930, 49-58). The writer has given an account of all the specimens of *Peltigera* or *Peltidea* in the herbarium of Acharius, and has compared them with specimens of his own collection. He unites *Peltigera spuria* with *P. pusilla* and also with his own species, *P. Hazslinszkyi*. The one named by him, *Peltigera rufescens* var. *spinei*, must now rank as var. *palmata* (Del.). *P. membranacea* corresponds with his *P. Szatalæ*. A. L. S.

Notes on Lichens.—V. GYELNIK ("Lichenologiai Közlemények 20-45," *tom. cit.*, 24-35, 2 pls.). The notes give an account of *Peltigera* from Sagalien (Abbé Fauré), an account of *Nephroma* spp., and notes on a series of lichens in the Bot. Museum at Berlin-Dahlem. He has given very exact studies of species of *Parmelia*, *Pertusaria*, *Lecanora*, etc. A. L. S.

Deformations in Cladonia.—E. BACHMANN ("Die Podetien von *Cladonia mitis* Sandst. im hohen Norden," *Ber. Deutsch. Bot. Gesell.*, 1930, 48, 145-52, 1 text-fig.). Specimens of *Cladonia mitis* with small protuberances on the thallus were submitted to Bachmann for examination. He has now published an exact account of the tissues affected. He found no trace of fungus infection, and has decided that the pycnidia-like bodies were connected with adventitious growths induced by the extremely cold conditions in Spitzbergen and Oldenburg, where the plants were collected. An exact account is given as to the presence or absence of gonidia, the size of the cells, and the brown colouration of the tips—whether stunted or of longer growth. A. L. S.

Lichenological Notes.—V. W. WATSON (*Journ. Bot.*, 1930, 68, 265-70). Watson gives a continuation of his notes and observations on British lichens. In addition to many new localities for rare species, he adds species new to the British flora, and one species new to science, *Biatorrella flavo-cinerea*, near to *B. flava*. A. L. S.

Red Species of Usnea.—JOHANNES HILLMANN ("Einige Bemerkungen über die roten Usneen," *Rep. Spec. nov. regni vegetabilis*, 1930, 27, 287-91). Hillmann notes that the first red *Usnea* to be chronicled was from Canada, *U. florida* var. *rubignea* Michaux. Hillmann finds six different red plants recorded, and he has given them as varieties of the species to which they are most nearly related. He gives a key to these red-coloured lichens and a description of each. They are all corticolous and are widely distributed. By several lichenologists some, at least, of these are distinguished as true species. A. L. S.

Lichens of a Town Neighbourhood.—PÅL K. HAUGSJÅ ("Ueber den Einfluss der Stadt Oslo auf die Flechtenvegetation der Bäume," *Nyt. Nag. Naturvid.*, 1930, 68, 1-116, 10 pls.). The writer has followed and considerably amplified the work of Nylander and Arnold in their records of lichens that survive in the near neighbourhood of towns. He has concentrated on Oslo, on the parks and open places in and around the town, and gives records of the trees, with particulars of size and orientation. It is almost entirely the older trees that are the habitats of lichens—*Ulmus*, *Acer* and *Fraxinus* being the most common trees. Within the town area *Lecanora Hageni* on trees is the commonest species, and in freer areas *Physcia tribacia* and *Candelaria concolor*, with *Parmelia sulcata* and *P. physodes* in small quantities. As the distance from the town increases, so do the number and variety of the lichens, and various signs and numbers which Haugsjå explains are used to denote frequency, etc. The author has tested 126 different stations. A special section is devoted to notes on the more abundant species, and a final account follows in which are described the factors that influence the lichen vegetation and their effect on different species. The influence of light is important, and the interference of dust and smoke with its intensity, and the effect of these on assimilation is considered. The tendency is for the lichens to have smaller lobes and an inferior development the nearer they are to the centre of the town. In these localities lichens also develop by preference at the base of the trees. Isidiose lichens are more abundantly covered with isidia near the town. The effect on soredia was not so clear. The species designated as *Leptra* spp., though generally considered to be imperfect developments, are judged by the writer to be true *Leptra* species. He never found in these any trace of more advanced growth. The formation of apothecia is seriously affected by town conditions, and those present are frequently deformed, though spore formation is normal. He has followed Sernander in recognising three distinct zones, in the centre of the town a "desert zone," farther out a "struggle (Kampf) zone," and beyond these a "normal zone," though the boundaries are indistinct. In all, he lists some 64 lichens, and tables are given which set out their relative distribution. A list of the literature consulted is given. A. L. S.

Mycetozoa.

New Genus of Mycetozoa.—CH. MEYLAN ("Note sur un nouveau genre du Myxomycètes," *Bull. Soc. Vaud Sc. Nat.*, 1930, 57, 147-9, 4 text-figs.). The mycetozoon described was found by Meylan near the snow-line in May, 1929. It is related to *Lamproderma*, and exteriorly recalls the genus *Diachæa*; it has therefore been described as *Diacheopsis metallica* gen. et sp. nov. A detailed description is given, and the reasons for establishing the new genus. A. L. S.

American Mycetozoa.—ROBERT HAGELSTEIN ("Mycetozoa from Jones Beach, State Park," *Mycologia*, 1930, 22, 256-62). The locality in which the mycetozoa were collected lies on the south coast of Long Island. The

species, numbering 50, have been collected over a limited area for several years past. They grew on decaying grasses close to the sand, on drift-wood, paper, and other rubbish. A. L. S.

New Plasmodiophoracea.—C. H. OSTENFELD and H. E. PETERSEN ("On a New Plasmodiophoracea found in Canada," *Zeitschr. für Bot. Festschrift zum 70. Geburtstag von Friedrich Oltmans*, 1930, 23, 13–17, 6 text-figs.). The organism was found on a water plant, a species of *Heteranthera*. It attacks the roots, causing hypertrophy and darkening of the roots. The authors have described the development of the parasite, the multinucleate plasmodium, and the formation of spores. The infection stages were not seen. It is near to *Sorosphaera* or *Tetramyxa*, but has been given new status as *Membranosorus Heterantheræ* gen. & sp. nov. A. L. S.

TECHNICAL MICROSCOPY.

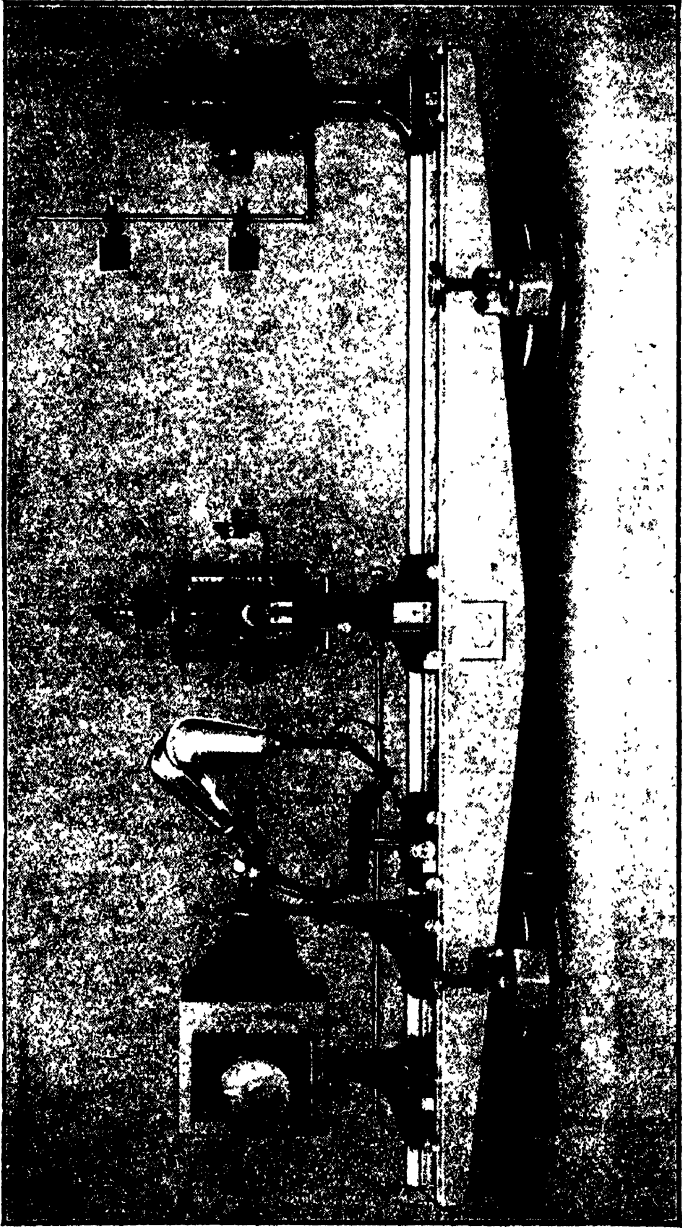
The Mounting of Textile Fibres.—J. M. PRESTON (*Journ. Soc. Dyers and Cols.*, 1930, 46, 295). For the permanent mounting of sections of textile fibres the ratio of the refractive indices of section and mounting medium should be in the region of 1.06, the mountant having the lower refractive index. When examining for impurities in the fibres, a medium having the same refractive index as the fibres should be used, so as to render the object practically invisible. For cellulose acetate silk, glycerine jelly is recommended for contrast mounting and euparal for rendering invisible. Collodion is used for the contrast mounting of other fibres, and Canada balsam for rendering invisible. Cellulose acetate silk is very difficult to mount owing to the swelling effect of most mounting media, but those given above have been found to produce the best results. A. H.

Beck-Hadfield Metallurgical Microscope.—Metallurgical microscopes of the inverted type, when the object is placed upon the stage and observed from below, have been developed to such an extent and possess so many adjustments that they have become difficult in use, and have tended to lose their rigidity, as a result of the elaboration of their parts.

Modern research has shown that, if the correct method of illumination is employed, no further adjustments can improve the results, and that the whole of the illumination adjustments can be dispensed with and all parts fixed except the lamp. Exceptional illumination can be made by means of suitable diaphragms. Thus the microscope is always ready for doing the most exacting high-power work.

The exceptionally rigid design of the Beck-Hadfield metallurgical microscope ensures that the adjustments, once having been made, will not alter. The optical bench is supported on four levelling screws, or can be supported on two large discs of rubber or other anti-vibration material. The upper surface of the bench is in the form of a V and flat slide, and is 68 inches long. A divided scale is provided on the slide, so that the positions of the apparatus can be registered.

The microscope is on a heavy carriage sliding on the optical bench. The stage



Fig

of the microscope is carried on a massive slide actuated by a rack-and-pinion and provided with a clamp. The stage has concentric rotating and mechanical motions to move the object in either direction.

The fine adjustment carries the object-glass alone, and is supported on a slide 6 inches long, fitting on the opposite side of the fixed column of the carriage to the coarse adjustment, actuated by a double lever and by two milled heads. Either milled head can be used by hand. The one on the left-hand side is finer than the other, and a rigid rod can be fixed to this, which extends along the bench to the ground-glass end of the photographic camera, forming a connection entirely free



FIG. 2.

from backlash. As nothing but the object-glass is moved, greater delicacy can be obtained than when heavy overhanging parts require to be moved.

There are two body tubes, both horizontal, but one pointing along the length of the bench, connecting with the camera for photography, and the other at right-angles towards the observer, for visual observation. The image is reflected into either one or the other by means of a right-angle prism.

The observing tube has a fixed tube-length for which all the lenses are corrected. The photographic draw-tube has a small adjustment with a divided scale, so that the focus on the ground glass can be set to exactly correspond with the focus through the observing tube at different lengths of camera extension.

Object-glasses are attached to the microscope by means of rapidly-operated changers. They can be separately adjusted, so that they are interchangeable for centration.

A small screen is fixed on the photographic tube at a distance from the vertical optic axis approximately equal to that of the back lens of the object-glass from the horizontal axis, so that the character of the beam of light that is being passed through the object-glass can be observed. A revolving obscuring disc covers this screen when it is not being used.

A $6\frac{1}{2}$ inches by $4\frac{1}{2}$ inches camera is fixed on two carriages, one of which carries the box portion of the camera with the plate holder, two ground glasses and reflex mirror; the other carries the front with light-tight connection to the microscope tube.

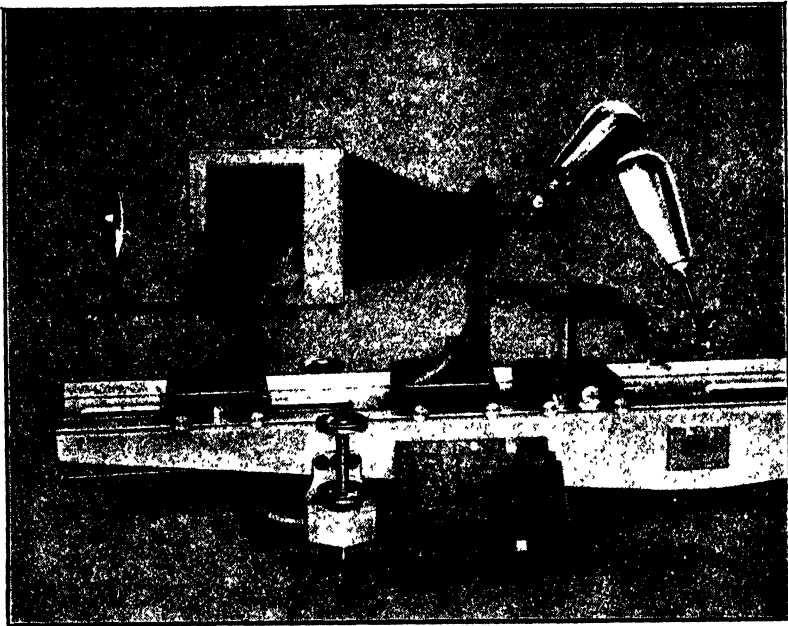


FIG. 8.

A large magnifying lens is provided for observing the image on either ground glass.

The illumination for metallurgical work is on the system described by Wrighton and Beck in the *Journal of the Royal Microscopical Society*, June, 1927. It is an innovation in metallurgical illumination in that it is fixed in the correct manner and there are practically no adjustments. The lamp can be adjusted in case the bulb is replaced. Two iris diaphragms can be opened and closed, or special stops, such as the Carl Benedick epiphragms or other diaphragms, can be introduced, but everything else is fixed. The rigidity of the whole apparatus renders this possible. The illuminating train will not move out of alignment, and the instrument is always ready for the most exacting work, and much of the difficulty of high-power metallurgical research is removed.

The apparatus also comprises a means of photographing small objects, without the use of the microscope, when small magnifying powers are required. With the

microscope, magnifications from about 20 to 5,000 or more can be obtained, but with the microscopic apparatus, powers from about 3 to 15 are obtained.

A separate table to hold the object fits upon the optical bench, and a series of microstigmat photographic lenses with a prism fit on the front portion of the camera. The table is provided with a levelling stage, and a rack-and-pinion moves the table up and down for focusing. Around this table is a revolving plate, carrying two arms with universal movements, with electric lamps for giving any desired illumination to the object on the table.

In order to render the microscope complete for all forms of work, as well as for metallurgy, a mirror and substage are provided for the examination of transparent objects.

The Beck No. 30 Inverted Metallurgical Microscope.—This microscope is a smaller type of inverted microscope embodying the principles of the Beck-Hadfield microscope, but in which the long optical bench is replaced by a short and non-adjustable base. The positions of the illuminating apparatus and the microscope are fixed, and the only movable element is the camera, which can be extended to any distance between 10 and 20 inches from the eyepiece of the microscope. It is fitted with all the necessary adjustments for microscopic metallographic purposes.

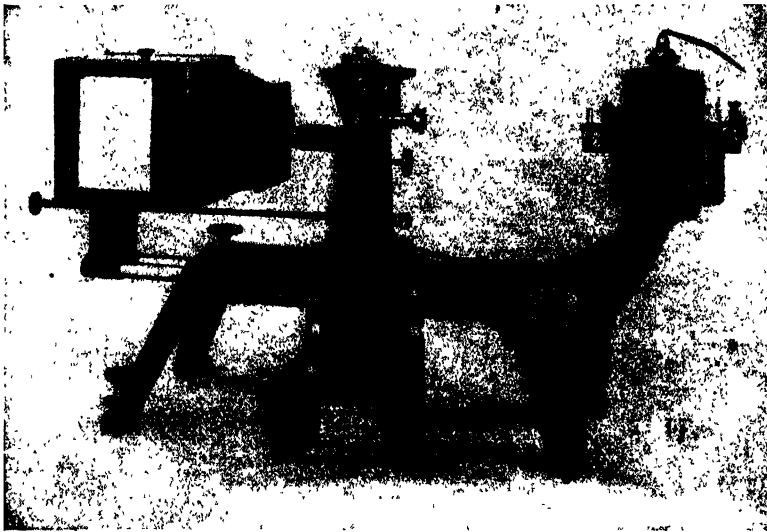


FIG. 4.

The microscope element is of the same rigid construction as the Beck-Hadfield. The coarse adjustment is unusually rigid, and can be clamped in any position. The fine adjustment is very delicate, as it carries nothing but the object-glass, and is free from backlash. The stage is cut away in the front, which enables the object-glasses to be changed and observed with great ease.

The microscope carries a thin glass vertical illuminator or a prism illuminator, both of which are provided with tilting motions in two azimuths. It also carries a collimator and iris diaphragm placed at the correct tube-length distance from the reflector, by means of which the distance from the lamp to the microscope is shortened, enabling the whole apparatus to be made more compact.

The microscope has two tubes at right angles. One is parallel to the bench, and is connected to the camera; the other is at right angles to the bench for observation. The image is thrown from one to the other by the movement of the prism, which is stopped in the correct positions. The tube for photography has an adjustment with a divided scale, so that the focus through the two tubes can be made to correspond for any camera extension.

The lamp usually supplied is a Pointolite contained in a housing, which can be adjusted by two screw motions to set the bulb to the exact position.

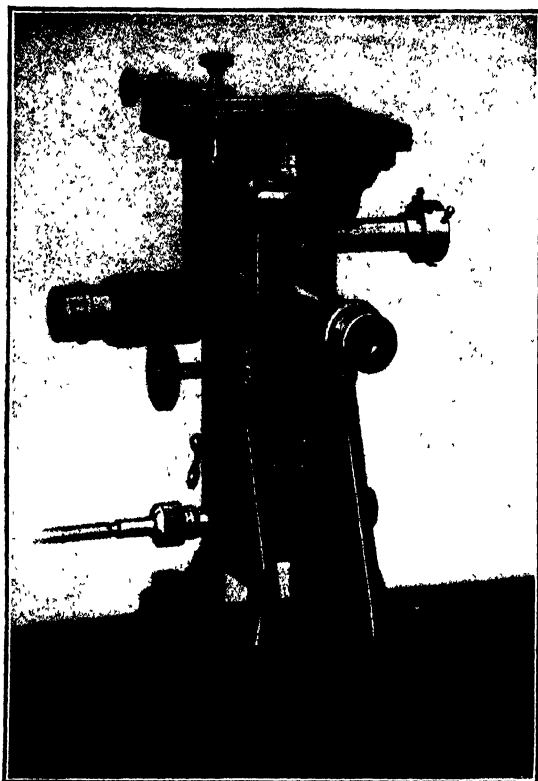


FIG. 5.

The illumination is on the Beck-Wrighton system described in the Journal of the Royal Microscopical Society, June, 1927.

A condenser fixed to the lamp element projects an enlarged image of the source of light upon the iris diaphragm of the microscope collimator. It is provided with an iris diaphragm which varies the effective size of the condenser. The adjustment of this iris diaphragm and of the iris diaphragm of the microscope collimator gives complete control of the illumination. The condenser diaphragm limits the size of the beam of light which passes through the object-glass. The microscope iris diaphragm limits the area of the object that is illuminated. Epiphragms or colour filters can be inserted at the lamp condenser.

The camera is either a plain $\frac{1}{4}$ plate or $\frac{1}{2}$ plate ($6\frac{1}{2}$ inches by $4\frac{1}{2}$ inches) camera, or

can be supplied in the $\frac{1}{2}$ -plate size with a folding reflex mirror which enables the image to be observed at the side of the camera while the photographic plate is in position at the back.

The apparatus may be supplied with four levelling screws, or without these it will stand rigidly if placed on four rubber or felt pads.

If an anti-vibration device is required, it is recommended that it be placed on a stone or concrete slab supported on a mat of sorbo rubber 1 inch thick. Some observers prefer to use two slabs of stone or concrete and two rubber mats.

In the simplest form of the apparatus the stage of the microscope is quite plain, but it is provided with the necessary fixing for the attachment of a mechanical stage with rack-and-pinion adjustments in both directions.

NOTICES OF NEW BOOKS.

La Variation et l'Évolution. Vol. II. L'Évolution.—By E. GUYÉNOT. 1930. 414 pp., 5 text-figs. Published by Librairie Gaston Doin & Cie, 8, Place de l'Odéon, Paris (V^e). Price 32 fr.

Enzymes.—By J. B. S. HALDANE, M.A. 1930. vii + 235 pp., 35 text-figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C. 4. Price 14s. net.

Bacteriological Technique.—By J. W. H. EYRE, M.D., M.S., F.R.S. Edin. 3rd edition. 1930. xii + 619 pp., 238 text-figs. Published by Baillière, Tindall & Cox, 7 & 8, Henrietta Street, Covent Garden, London, W.C. 2. Price 21s. net.

Microscope Record.—No. 21. September, 1930. 32 pp., 17 plates and text-figs. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C. 1.

Lecture Experiments in Optics.—By B. K. JOHNSON, F.R.M.S. 1930. 112 pp., 90 text-figs. Published by Edward Arnold & Co., 41 & 43, Maddox Street, London, W. 1. Price 8s. 6d.

The Beginner's Guide to the Microscope.—By CHAS. E. HEATH, F.R.M.S. Revised edition. N.D. 120 pp., 46 text-figs. Published by Percival Marshall & Co., 66, Farringdon Street, London, E.C. 4. Price 1s. 6d. net.

Index Animalium.—By C. D. SHERBORN. Part XX, pp. 4931–5138. October, 1929. Part XXI, pp. 5139–5348. December, 1929. Part XXII, pp. 5349–5702. June, 1930. Published by the British Museum (Natural History), Cromwell Road, London, S.W. 7. Price 10s. each part.

The Use of the Microscope: A Handbook for Routine and Research Work.—By JOHN BELLING. 1930. viii + 315 pp., 21 text-figs. Published by the McGraw-Hill Publishing Co., Ltd., 6 & 8, Bouverie Street, London, E.C. 4. Price 20s. post free.

The book aims at being a complete course of instruction in the technique of the microscope. The training is graduated into five steps, and a large number of rules for obtaining the best results are given. The results of attending to these rules and of disregarding them are described. A tabulated list of causes of injury to the microscopical image, the injury produced by these causes and the remedy, together with some rules for optimum high-power microscopy, conclude the introductory portion of the book. The use of hand magnifiers, the compound microscope, the twin-objective binocular and the mon-objective binocular, is described in considerable detail, and the advantages of the various instruments are discussed. The microscope most suitable for routine work is then considered, and questions of illumination, light filters, condensers, both dark and light ground, objectives for various purposes, and their testing, are described. The subject-matter of each chapter is summarised in the form of "practical points."

The mirror, stage, nosepiece, and draw-tube are discussed, and eyepieces are described. The question of microscope outfits and the possibility of labour-saving in the use of the microscope are considered. Methods of photography and drawing are given in considerable detail. A chapter on the testing of microscopes, the care of the microscope, and rules on high-power work and routine microscopy are included. The preparation of one hundred microscopical objects of biological interest and a list of fifty excellent practical exercises with the microscope are described. References to the literature on the microscope are scattered throughout the text, as well as given as a list.

The book at first sight seemed to be a very excellent text-book, but, on reading through, doubts began to arise as to the wisdom of the treatment. To the reviewer it seemed that too much had been attempted for the space at the author's disposal, and the long succession of details, rules, and statements had an effect of discouragement and repulsion. If a student of microscopy had the perseverance to work through the book and master the rules, there is no doubt that he would be a very expert microscopist, but the reviewer doubts whether the human perseverance of a student would stand the strain of the repetition of so many rules. At the same time there are distinct uses of the book as a reference, and one is almost certain to find information on any point which may arise, and a starting point for further reading suggested in the references to current literature. On page 95 there is a reference to the cilia on diatoms, but the present writer has never been able to see them. The book is well got up, and, despite its limitations, it cannot fail to form a useful addition to the scanty library on microscopical technique.

F. J. B.

Die optischen Instrumente Brille, Lupe, Mikroskop, Fernrohr Aufnahme-linse und ihnen verwandte Vorkehrungen.—By Dr. MORITZ VON ROHR. 1930. 130 pp., 91 text-figs. Published by Verlag von Julius Springer, Berlin.

It is not surprising that this little book, of which 15,000 copies have already been sold, has now arrived at its fourth edition, as in its way it is quite unique. Compressed into the minimum compass, and starting with an introduction to the fundamental ideas governing optical instruments, it passes on from the eye itself (regarded first in the old manner as a fixed camera obscura, and then in accordance with the changes involved by taking account of its rotational and other functions) to a complete survey of optical instruments and appliances, from spectacles and

lenses to microscopes, telescopes, stereoscopes, and almost every other class of optical instruments and appliances. It is intended for the intelligent user rather than for the constructor of optical instruments, although the latter would find many points of interest in it, owing to the differences in the outlook and treatment of the subject in German and English text-books. Not only is the wealth of information to be found in this book—which is imparted in the lucid and systematic manner to which Dr. von Rohr has accustomed us in his many papers and work on optical subjects—remarkable, but it is usually accompanied by names and dates enabling the reader to follow the history of the development of the instrument or appliance to which he may wish to refer. The reviewer knows of no other book dealing with optical instruments of every description giving an equal amount of information in so condensed a form, and as the handiest little reference book it cannot be surpassed.

The fourth edition, somewhat enlarged, has been brought up to date and has been recast. It distinguishes itself from previous editions by a good deal of additional information, and for German readers some stress is laid on the fact of the purity of the German and the elimination of foreign expressions. Whilst the latter has little value for the English reader, there is one point about the new edition of very distinct benefit, namely, that instead of being printed in German characters on rather poor paper, like the former ones, this edition is printed in Latin characters on good paper and with good illustrations. J. R.

Grundlagen der praktischen Optik.—By Dr. M. BEREK. 1930. vii + 152 pp., 1 plate, 63 text-figs. Published by Walter de Gruyter & Co., Genthiner Strasse 38, Berlin W.10. Price RM. 13.

This booklet deals with lens systems and their aberrations from the standpoint of geometrical optics. The subject-matter of such a book must of necessity be largely mathematical and must be expected to follow conventional lines fairly closely; there are, in fact, three or four publications in English which cover much the same ground as the publication under review.

The author has restricted his mathematical analysis to the minimum necessary for the practical designer, and has infused into the book a readableness not commonly associated with publications dealing with geometrical optics. The mathematical analysis is treated adequately, and the way in which such analysis is made use of is explained with one or two examples to illustrate its application. The author points out that such analysis, when used in its legitimate sphere, may be of great value, but indicates its limitations very definitely in a sentence on page 41, which may be translated as "whoever expects as a general rule to obtain immediately the components of a well-corrected system by solving a few equations will, in most cases, be disillusioned."

The last chapter of the book deals with the light-intensity in optical systems, leading finally to the development of an expression for the intensity or brightness of the image produced. The principles underlying this chapter are generally well understood by designers, and the importance of considering optical systems from this point of view is well recognised; the inclusion of this chapter is, however, particularly welcomed since there is comparatively little reference to these matters in the literature of the subject. H. M.

Recent Advances in Chemotherapy.—By G. M. FINDLAY, O.B.E., M.D., D.Sc. 1930. viii + 532 pp., 4 plates, 11 text-figs. Published by J. & A. Churchill, 40, Gloucester Place, London, W.1. Price 15s. net.

This is an excellent work of reference, well up to the standard of the other works in this series. J. A. M.

Histology for Medical Students.—By H. HARTRIDGE, M.A., M.D., Sc.D., M.R.C.P., F.R.S., and F. HAYNES, M.A. 1930. xii + 400 pp., 502 illustrations in colour and 12 in black-and-white. Published by Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C. 4. Price 15s. net.

This addition to the many handbooks of histology possibly errs on the side of over-simplification, which is a doubtful advantage for the medical student who must shortly pass to the intricacies of pathological histology. The text is admirably clear and concise. The reviewer regrets the decision of the authors to adopt coloured figures based on a routine hæmatoxylin-eosin technique. The plates, especially of the organs of special sense, fulfil all the authors claim for them. A higher magnification could have been adopted with advantage for some of the other organs, notably the kidney.

J. A. M.

Histological and Illustrative Methods for Entomologists.—By H. ELTRINGHAM. With a Chapter on Mounting Whole Insects, by H. BRITTEN. 1930. xii + 139 pp., 1 pl., 21 text-figs. Published by Humphrey Milford, Oxford University Press, London. Price 7s. 6d. net.

As the author states in his introduction, "This little handbook does not aspire to be a text-book of invertebrate histological technique. Indeed, the subject can hardly be regarded as sufficiently advanced for the production of a volume in any way comparable to the available manuals on the staining and preparation of vertebrate tissues. It is rather an attempt to describe, for the sake of those who have not had the advantage of laboratory training, the more elementary methods of entomological section-cutting and microscopic entomology."

It seems questionable, however, whether there is much essential difference between the requisite preparation and staining of vertebrate and invertebrate tissues as a whole, and also whether "those who have not had the advantage of laboratory training" are given in this little book a sufficiently complete account of histological methods to enable them to deal quite successfully with the material of their studies.

There is much useful information of an elementary nature throughout the book, but the reader is inclined to expect from its title more than it provides. It caters less for the needs of entomologists in general—whether laboratory trained or not—than for those of the enthusiastic amateur of the "butterfly-collector" type who has an ambition to use a microscope and a microtome to augment his collections with slides and other exhibits.

The principal subject-matter of the book is divided into nine chapters having the following titles: "Apparatus, Reagents, and Material," "Preparations of Wing Neurulations, Scales, etc.," "Genitalia Preparations," "Fixing, Embedding and Section-Cutting," "Staining and Other Processes," "On Making Preparations of Small Whole Insects" (by Mr. H. Britten, the author's collaborator), "On Making Drawings," "On Colouring Lantern Slides and Photographs," and "On Model Making." The field of the book is, therefore, wide—too wide, in fact, to be more than casually surveyed by the restricted excursion made by the author and his collaborator—while many of the important aspects have been neglected almost entirely. Thus, of the various methods of dissection, the mounting of whole organs, the best methods of preparing and examining different instars, the important mountants other than balsam and euparal, little or nothing is said.

The most commendable section of the book is that dealing with microtomy

and its associated processes, where readers will find a good summary of the principal manipulations for paraffin and celloidin embedding, together with useful formulæ and methods of using reliable fixatives and stains. M. E. M.

Diatoms as Insulators.—By W. HUGILL ("Diatomaceous Earth. Part 1. The Structure and Properties of Diatoms in Heat Insulating Materials," *Journ. Ceramic Soc.*, Sept., 1930, 1–15, 8 pls.).

A review of the nomenclature and occurrence of diatomite is followed by a morphological and physiological description of the diatom. A large number of cross-sectional measurements of the diatoms were made and tabulated, and the internal dimensions and volumes calculated for a number of species. The pores in insulating bricks are of three types. 1. Voids between diatoms and air-bubbles occluded when the mass is plastic. 2. The internal cavities of the diatom frustule. 3. The minute chambers due to the sculpturing on the valve. Pores which exceed 0.1 mm. in diameter are visible to the naked eye, transmit heat by convection, and are of little value in heat insulators at high temperatures; further, the degree of comminution and density of the diatomite have a direct effect on the insulating value. Diagrammatic representations of nuclear division are appended, together with numerous photomicrographs of discoid and pennate diatoms, diatom sections, and a new form of microscope for simultaneous comparison and examination of two samples of diatomaceous earth. N. I. H.

Diatomite: its Analysis and Use in Pharmacy.—By N. INGRAM HENDEY. Reprinted from the *Quarterly Journal of Pharmacy and Pharmacology*, 1930, vol. III, no. 3, pp. 390–407.

This suggestive little pamphlet does not claim to be "in any way exhaustive, but merely seeks to present a few useful facts which may serve to direct future work." It was probably written because the only paper the author found dealing with the subject from a purely pharmaceutical point of view was published in the *American Journal of Pharmacy* so far back as 1912. The most valuable part of the paper is that on the analysis of diatomite, chemically, physically, and microscopically, all with a view to its adaptability to pharmaceutical purposes. The most essential and infallible test for diatomite is microscopical: it is by this means that the value of a sample may be estimated quickly and accurately. It is the only means that will determine the nature and type of diatoms present and detect impurities. The characteristics of eight samples of diatomite from South Russia, Algeria, Germany, California (three samples), New Zealand, and England, were examined by the author with regard to their suitability for filtration, absorption, abrasion and toilet purposes. A notable omission from the short bibliography concluding the pamphlet is V. L. Eardley-Wilmot's "Diatomite: its Occurrence, Preparation, and Uses," published by the Canadian Department of Mines in 1928. J. A. L.

The Development of Sex in Vertebrates.—By F. W. ROGERS BRAMBELL, B.A., Ph.D., D.Sc. Text-books of Animal Biology, edited by Prof. Julian S. Huxley. 1930. xvi + 261 pp., 24 pls., 25 text-figs. Published by Sidgwick & Jackson, Ltd., London. Price 12s. net.

Prof. Rogers Brambell has succeeded in weaving the recently-established facts concerning the morphology and physiology of the gonads and the genetics of sex determination into a fascinating story told in such a way as to form an excellent text-book for the serious student. The book gives a very careful description and analysis of the stages by which, in the vertebrate, the sex characters are gradually

realised. The close interrelationship of structure and of function is everywhere stressed, and running all through the book there is to be recognised the author's deep interest in the evolutionary aspect of sex. The book is exceedingly well illustrated, and is the best summary extant of existing knowledge. Both in the text and in the extensive bibliography the author does full justice to all authors save himself.

F. A. E. C.

Embryology and Evolution.—By G. R. DE BEER. 1929. viii + 116 pp., 7 illustrations. Published by Humphrey Milford, Oxford University Press, London. Price 5s. net.

The theory of recapitulation, as generally accepted by zoologists, is here attacked in a manner which, though it may irritate, will at least stimulate the majority of embryologists. Many facts are recorded which are difficult to explain on the orthodox theory, more especially the work of Goldschmidt on the gipsy moth, *Lymantria*, as a result of which it has been shown that genes vary quantitatively as well as qualitatively, and, in addition, that their effects in ontogeny are exerted at certain definite rates dependent on their quantitative values. It follows that mutations may produce changes in the time at which characters develop in ontogeny. New characters may thus appear at all stages of ontogeny, and may be retarded or accelerated so as to appear earlier or later in subsequent ontogenies. The book was well worth writing, and should be read by all who are interested in the theories of evolution.

G. M. F.

Genetics of the Protozoa.—By H. S. JENNINGS. *Bibliographia Genetica* (The Hague), 1929, 5, 105–330, 9 charts, 22 text-figs.

In this work Prof. Jennings has made a very complete review of our present knowledge of genetics in the protozoa. A detailed summary is given of all the most important investigations "on the production, transmission, and alteration of hereditary diversities" in these organisms. The subject-matter is arranged more or less in chronological order of the works dealt with. An impartial account of these is followed by a critical discussion. Part I deals with investigations of the normal life-cycle, with special reference to the effects of conjugation and endomixis. From the evidence available it is concluded that in conjugation renewal of the macronucleus results in rejuvenescence, in cases where the vitality of the animals has become impaired, while by exchange of nuclear material new combinations are formed, resulting in the formation of individuals with altered physiological and structural characteristics. Part II is devoted to a consideration of the occurrence, origin, and inheritance of hereditary diversities. Here the author discusses the work on selection with respect to normal and abnormal characters, and on experimental modifications in various Protista. A brief summary and interpretation of the questions dealt with are given in a final *résumé*. A useful list of references and a subject index are appended at the end of the book. The work as a whole provides a well-documented historical and critical account of the development of genetics of the protozoa, written by one of the foremost authorities on the subject, and is a welcome addition to protozoological literature.

C. A. H.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C. 1, ON WEDNESDAY, OCTOBER 15TH, 1930.

It being the opening meeting of the Session and the first meeting in the Society's new premises, the President and Mrs. R. Ruggles Gates held an informal reception of the Fellows and their guests at 5 p.m. in the Common Room.

At 5.30 p.m. Prof. R. Ruggles Gates, M.A., Ph.D., LL.D., President, took the Chair.

The Minutes of the preceding Special General Meeting of Fellows, held at 20, Hanover Square, on Wednesday, May 14th, and of the Ordinary Meeting held at King's College, Strand, on May 21st, 1930, were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Lionel Percy Clarke, M.R.C.S., L.R.C.P., Brighton.
John Massey Preston, B.Sc., A.I.C., Chorley.

Nomination Certificates in favour of the following candidates were read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

Percy George Terry Hand, F.I.C., Chingford.
Harold Inglesent, Manchester.
Prof. Viktor Langhans, D.Sc., Prague.
Albert G. Novis, M.P.S., Hove.
Cecil Douglas Reyersbach, London.
Prof. Moritz von Rohr, D.Ph., Jena.
U. D. Solomon de Silva, London.
Robert Low Smith, F.C.S., Erith.
George William Wigg, M.B., B.Sc., Doncaster.

Donations were reported from :—

Messrs. McGraw-Hill Publishing Co., Ltd.—

“The Use of the Microscope.” By J. Belling.

Messrs. Sidgwick & Jackson, Ltd.—

“The Development of Sex in Vertebrates.” By F. W. Rogers Brambell.

Prof. M. von Rohr—

“Die Binokularen Instrumente.” 2nd edition.

“Ernst Abbe. Gesammelte Abhandlungen.” Vol. III and Vol. IV, Part 1.

Dr. G. M. Findlay, O.B.E., F.R.M.S.—

“Recent Advances in Chemotherapy.” By G. M. Findlay.

Prof. L. H. Tiffany—

“The Oedogoniaceæ.” By L. H. Tiffany.

Messrs. Walter de Gruyter & Co.—

“Grundlagen der praktischen Optik.” By M. Berek.

MM. Gaston Doin & Cie—

“La Variation et l'Évolution. Vol. II. L'Évolution.” By E. Guyénot.

Messrs. Longmans, Green & Co., Ltd.—

“Enzymes.” By J. B. S. Haldane.

Oxford University Press—

“Histology for Medical Students.” By H. Hartridge and F. Haynes.

“Histological and Illustrative Methods for Entomologists.” By H. Eltringham.

Mr. N. Ingram Hendey, M.P.S.—

“Diatomite, its Analysis and Use in Pharmacy.” By N. Ingram Hendey.

Sample of Diatomaceous Earth from Jutland.

1 Micro Slide of *Stephanodiscus Nova-Zelandicus*.

Messrs. Flatters & Garnett, Ltd.—

1 Micro Slide of *Pleurosigma terryanum* mounted in Hyrax and in Styra for comparison.

Mr. G. Dallas Hanna—

Sample Tube of Hyrax.

Mr. R. Maxwell—

A Double-Reflecting Microscope of the Culpeper Type c. 1740. (Donated on loan.)

Mr. A. Lucas, F.R.M.S.—

One guinea.

Mr. E. Heron-Allen, F.R.S., F.R.M.S.—

Sixteen pounds (£16).

The Royal Society—

Two hundred pounds (£200).

Votes of thanks were accorded to the donors.

Papers.—The following communication was delivered and discussed :—

Dr. G. M. Findlay, O.B.E., M.D., D.Sc., F.R.M.S.—

“Some Recent Research on Malarial Parasites.”

Mr. J. E. Barnard, F.R.S., F.Inst.P., F.R.M.S., gave a summary of “Some Experimental Studies in Diffraction,” by the late Mr. F. W. Shurlock, which the Council had passed for publication in the forthcoming volume of the Society’s Journal.

Mr. J. E. Barnard then gave a demonstration of the micro-projection of histological and bacteriological preparations with the Society’s optical bench apparatus which he had recently re-conditioned.

Hearty votes of thanks were accorded to Dr. G. M. Findlay for his communication, and to Mr. J. E. Barnard for his demonstration and for kindly renovating the Society’s optical equipment.

Votes of thanks were also accorded to Messrs. R. & J. Beck, Ltd., and to Messrs. E. Leitz (London), for the loan of microscopes.

Announcement.—The President announced that the Biological Section would meet in the Pillar Room, B.M.A. House, on Wednesday, November 5th, 1930, at 6 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, NOVEMBER 19TH, 1930, AT 5.30 P.M., PROF. R. RUGGLES GATES, M.A., Ph.D., LL.D., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Percy George Terry Hand, F.I.C., Chingford.
Harold Inglesent, Manchester.
Prof. Viktor Langhans, D.Sc., Prague.
Albert G. Novis, M.P.S., Hove.
Cecil Douglas Reyersbach, London.
Prof. Moritz von Rohr, D.Ph., Jena.
U. D. Solomon de Silva, London.
Robert Low Smith, F.C.S., Erith.

Signing the Roll—The following gentlemen, having subscribed their signatures to the Roll, were received by the President, and formally admitted to the Fellowship of the Society :—

H. J. Harper-Roberts.
Albert G. Novis.
Cecil D. Reyersbach.
U. D. Solomon de Silva.

Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

Richard Watson Frow, Lincoln.
Roderick Francis Hunwicke, B.Sc., A.I.C., Barnet.
Frank J. Myers, Ventnor, N.J.

The Deaths were reported of :—

Bernard B. Woodward. Elected 1880.
Henry Charles Batchelor. Elected 1924.

Votes of condolence with the relatives were passed.

Donations were reported from :—

Messrs. Edward Arnold & Co.—

“Lecture Experiments in Optics.” By B. K. Johnson.

Prof. M. von Rohr—

“Die optischen Instrumente.” By M. von Rohr.

Votes of thanks were accorded to the donors.

Papers.—The President called upon Mr. R. J. Bracey, F.Inst.P., to deliver his communication on “A Universal Tube-Length and Cover-Glass Correcting Lens System for Use with Microscope Object-Glasses.”

A discussion followed, in which Mr. Akehurst, Mr. Barnard, Mr. Beck, Mr. Blood, Dr. Bowell and Sir Herbert Jackson took part.

The following paper was then read :—

Dr. W. E. Cooke, M.D., F.R.C.P., D.P.H., F.R.M.S., and Mr. C. F. Hill, M.Inst.M.M., A.Inst.P., F.R.M.S.

“Microscopical Studies in Pernicious Anæmia. I.—The Hæmoglobiniferous Cells.”

Prof. Gates (President), Mr. Barnard, Dr. Findlay and Dr. Pickering took part in the discussion that followed.

The following communications were read in title :—

Prof. A. Gandolfi Hornyold, D.Sc., F.L.S.—

“The Otoliths of Small Eels from the Rhine.”

Mr. G. Dallas Hanna—

“Hyrax, a New Mounting Medium for Diatoms.”

Dr. M. A. Fikry, B.A., B.Sc., Ph.D., F.R.M.S.—

“Phenomena of Heterotypic Division in the Pollen Mother-Cells of a Tetraploid Form of *Rumex scutatus* var. *typicus*.”

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The President announced that the next Meeting of the Biological Section would be held at the London School of Hygiene and Tropical Medicine, Keppel Street, by kind invitation of the School Council, at 5.30 p.m. on Wednesday, December 3rd, 1930.

The proceedings then terminated.

INDEX.

A

- Abraxas*, X-Radiation and the Spermatogenesis of, 90
Acanthocephalan, *Corynosoma stumosum* (Rudolphi), from the Californian Harbour Seal, An, 450
Acanthocladiella and *Heterophyllum*, 466
Acarospora, Monograph of, 278
 Aceto-Carmine, Permanent Staining with, 439
 Acrididæ, African, 237
Acrostalagmus, New, 475
Acrothecium obovatum, 367
 Acrydiinæ, African, 336
Actinococcus and *Sterrocolax*, 471
 — *Phyllophora* and, 131
Acuariidæ seurat, 1913, On a New Genus of the Nematode Family, 449
 Adelginæ of North America, 106
 Adrenalin on the Development of Amphibia, The Action of, 441
Aegilops Hybrids, Meiosis in *Triticum* and, 253
 — Meiosis in Hybrids of, 350
 — The Bearing of Chromosome Morphology on the Phylogeny of *Triticum* and, 254
Agaricus, Sexuality in, 138
 — Spores of, 369
Agaricus campestris, Cultures of, 138
 — *disseminatus* Pers., Systematy of, 273
Agraptocorixa, Australian, 237
Agraptinae, Studies on the Subfamily, 102
 Air, The Collections from, 443
 Albugo, Structure of Seed-Coat of, 461
Albugo candida, Forms of, 365
 Alder, Mycorrhiza of the, 276
 Alfalfa, Meiosis in, 356
 Algæ, American, 268
 — and Iodine, 472
 — Argentine, 364
 — Azores, 132
 — Belgian, 363
 — Bombay, 473
 — Brazilian, 472
 — Canary, 364, 472
 — Eastonian Freshwater, 267
 — Fossil, 130
 — from San Paulo, 472
 — Iodine of Marine, 268
 — Japanese, 473
 — Morocco, 269
 — Mosquitoes and, 267
 — of Banyuls, 269
 — of Spanish Morocco, 363
 — of Steppes, 268
 Algæ of the Riviera, 132
 — Protoplasm of, 467
 Alizarin-Molybdic Acid Lake in Staining, The Use of an, 433
Allomyces, Study of, 365
Alternaria Saltant, 135
 Alveolians, Eocene, 110
Ambystoma maculatum, The Larvæ of, 329
 Amœba, Cultivation of, 250
 — Factors Influencing Locomotion in, 250
 — Volumetric Studies on, 251
 Amœbæ from Various Animals, Intestinal, 116
 — Pathogenicity of Cultivated Dysenteric, 451
 Amœbiasis, Blood Picture in Experimental Feline, 250
 — in Kittens, Intestinal, 117
 — Observations on Human, 114
 Amphibia, Spermatogenesis in, 93
 — The Action of Adrenalin on the Development of, 441
 Amphibian Embryos, A Method for Separating, 434
 — Larvæ, Development of, 96
 Amphistomatous Parasites, Studies on Japanese, 341
 Anæmia, Microscopical Studies in Pernicious, 427
 Analytical Chemistry, Microscopical Methods in, 377
Ancylostoma braziliense, Quantitative Studies on the Dog and Cat Hookworm, 244
 — *caninum*, especially adapted to the Cat, Experimental Demonstration of a Strain of the Dog Hookworm, 242
 — Further Experiments with Physiological Strains of the Dog Hookworm, 242
 — Host-induced Variation in the Growth Curve of the Dog Hookworm, 450
 — Studies of the Blood Changes occurring in Young and Old Dogs during Cutaneous and Oral Infection with the Dog Hookworm, 244
 — The Effect of Age and Size of Infestation on the Egg Production of the Dog Hookworm, 449
 — The Influence of Temperature, Hydrogen-ion Concentration, and Oxygen Tension on the Development of the Eggs and Larvæ of the Dog Hookworm, 450
 — The Length of Life and Rate of Loss of the Dog Hookworm, 244

Ancylostoma caninum, The Reaction and Susceptibility of Dogs of Different Ages to Cutaneous Infection with the Dog Hookworm, 243
Ancylostomiasis and *Ascariasis* in Egypt, 244
Andropogon, Ustilaginales on, 368
 Angiosperms, Chromosomes of Diccious, 120
 Anilin Dyes in Histology, 227
 Animal Skin, Some Histological Studies of the Effects of Grubs upon, 378
 Anisol in Place of Cedar Oil for Immersion Oil, 88
Anopheles punctipennis, The Gametocytes of Tertian Malaria and their Early Appearance in Malaria transmitted by, 118
 Anopheline Breeding Conditions, 242
 Anophelini of Brazil, 238
 Anoplocephalid Cestode, A New, 448
 Ant Mounds, Populations of, 241
 Antheridia of *Plagiocbila*, 128
 Anthers, The Structure of Poricidal, 264
 Antigens on the Growth of Reticulo-endothelial Cells "in vitro," The Effect of, 92
 Anthracnose, Privet, 277
 — of Snowberry, 374
 Antibodies by Tissues Cultivated *in vitro*, The Fixation of, 234
 Ants and Tree-hoppers, 238
Aphanomyces, Fructification of, 365
 Aphids, Effects of Duration and Intensity of Light on, 105
Apistomyia, New Species of, 339
 Apothecia, Study of, 270
 Apothecial Development, 270, 474
 Apple Seedlings, Disease of, 479
 Apples, Fertility and Chromosome Number in, 351
 Araucarians, Growth Rings in Australian, 124
Arbacia, The Effects of Mercuric Chloride on the Eggs of, 327
 Archegoniatæ, Basque, 361
 Armadillo, The Formation of Mitochondria from the Nucleus of the Glandular Cells of the Vas deferens of the, 134
Armillaria mellea, 139
 Asbestosis, Further Observations on Pulmonary, 15
 Ascaris in two Villages in Panama, A Study of Reinfection after Treatment with Hookworm and, 242
Ascariasis in Egypt, *Ancylostomiasis* and, 244
Ascochyte on Leguminosæ, 135
 Ascomycetes, 366
 — Sexuality in the, 474
 — Spores of, 271
 — Study of, 271
Ascomphyllum, Molluscs in, 132
Asilids, Classification of the Australian, 443
 Asparagus, Root Rot of, 277
Aspergillus, New Species of, 366

Astrorhizidæ from Shallow Water, Further, 249
Asynapsis in *Zea Mays*, 459
Aucuba japonica, Chromosomes in, 256
 Azur II - Eosin Staining of Tissue Sections, Practical Hints on, 88

B

Babesia, Morphology and Division of, 453
 Bacilli in Sections at Low Temperatures, The Decolourization of Tubercle, 230
Bacillus lepræ and Myelin Sheath, A Stain for, 230
 Bacteria, A Flagella and Capsule Stain for, 437
 — as Food for Hookworm Larvæ, The Suitability of Various, 242
 — Cyanophycæ and, 468
 — in Tissues by Gram's Method, A Method of Staining, 439
 — of Cotton Disease, 277
 — The Staining of Polar Bodies in, 439
 — Variation in Fungi and, 275
 — Variations in Staining Character of, 87
 Bacterial Plant Disease, 277
 Bacteriological Staining Methods, The Development of, 325
Balantidium, Endomixis in, 451
Barbula rufa, 466
 Barley Mildew, 271
Basidiadiu, 469
 Basidiomycete Culture, 477
 Basidiomycetes, Japanese, 368
 — Nuclei of, 477
 — Sexuality in, 137
 Beck-Hadfield Metallurgical Microscope, 485
 Beet Leaf-Hopper, Life-History of the, 446
 Beetles, New Species of Eumolpid, 446
 — New Sumatra, 339
 — Reactions of Whirligig, 105
 Berlese's Mountant, Modification of, 106
 Biochemistry, The Recapitulation Theory and, 329
 Biological Races, 442
 Bird Malaria, Selection and Susceptibility to, 343
 Birds, Coccidiosis in Gallinaceous, 343
 — in Korea, A New Disease of, 234
Blastocladia, Study of, 364
 Blood Films, A Combined Peroxydase-Wright's Stain for, 436
 — Stained with Iron Hæmatoxylin and Giemsa's Stain, 439
 — Picture in Cats infected with Trypanosomes, 249
 — in Experimental Feline Amœbiasis, 250
Bombyx mori L., Abnormal Genitalia in, 446
 Bont-Tick, The Transmission of Heart-Water of Sheep by the, 328
Ros indicus, A Case of Intersexuality in, 441
Botrytis Forms, 475
 Braconidæ from the Kamtchatka Expedition, 339

- Brain Tissue, Differential Staining of, 87
- Brassica*, Interspecific Hybrids in, 256, 257
- Brassica-Raphanus* Hybrids, 257
- Bronchial Epithelium in the Lungs of Mice, Phagocytosis by, 328
- Bruchia vogesiaca*, 466
- Bryophyta, Iberian, 467
- in North Alps, Oceanic, 467
- Morvan, 467
- Bryophytes from New Guinea, 129
- of Montenegro, 129
- Serbian, 129
- Swiss, 362
- Bryopsis*, 130
- Bucephalidæ, Life-History Studies on the Trematode Family, No. 2, 342
- The Trematode Family, 108
- Buffers in Staining, The Use of, 435
- Bulinus*, The Radula of *Limnæa* and, 97
- Butterfly Migrations, 101
- Cadmium Fixation for the Demonstration of the Golgi Apparatus, The Use of, 323
- Callithamnion*, 363
- Calluna*, Endophyte of, 141
- Calonymphidæ, A New Genus of, 113
- Camels in Cyrenaica, Trypanosomiasis of, 118
- Cancer Problem, The Application of Dyes in the, 325
- The Rapid Diagnosis of, 434
- Carmine Method for Total Preparations, A New, 440
- Cats, Variation in the Thyroid Glands of, 328
- Cattle, A Study of Sarcosporidia in Korean, 116
- Caulerpa*, 471
- Cell Chemiotaxis, 326
- Nomenclature, 20
- Technique, Single, 438
- Cells, A New Technique for the Rapid and Certain Demonstration of the Chondriome in the, 323
- grown in Tissue Culture, The Morphology of Liver, 92
- in Tubercular Lesions, The Factors determining the Appearance and Frequency of Giant, 234
- "in vitro," The Effect of Antigens on the Growth of Reticulo-endothelial, 92
- of the Vas deferens of the Armadillo, The Formation of Mitochondria from the Nucleus of the Glandular, 234
- The Effect of Silica on the Growth "in vitro" of Cultures of Pulmonary, 92
- Cellular Degeneration, A Cytological Study of, 233
- Ceratopogoninæ from the Transvaal, 100
- Ceratostomella* and *Graphium*, 366
- Cercaria floridensis* in Relation to its Fish Intermediate Host, An Experimental Study of the Behaviour of, 448
- Cercaria* from North America, A Large-tailed Echinostome, 109
- of *Cotylurus michiganensis* (La Rue), 448
- Cercospora* Species, 135
- Study of, 475
- Cereals, The Bearing of Chromosome Morphology on the Phylogeny of, 253
- Cerosora*, 360
- Cestode, A New Anoplocephalid, 448
- Chaetomella* and *Pezizella*, Fructifications of, 367
- Study of, 366
- Chaetopterus*, Cleavage in the Egg of, 327
- Chalcid Wasps from the South Australia Museum, 445
- Chamaesiphon*, 130
- Chanterelle, New, 477
- Charophytes, Balkan, 132
- Chemiotaxis, Cell, 326
- Chemistry, Microscopical Methods in Analytical, 377
- Cherry Leaf-Spot Fungus, 374
- Chestnut and Oak, Large Leaf-Spot of, 142
- Chestnut Disease, 482
- Disease of, 276
- Chick-Pea, *Phyllosticta* on, 482
- Chironomidæ, British, 108
- Chlamydomonas*, Structure of, 453
- Chlorocyphella*, Study of, 376
- Chloroform and Acid Stains, 437
- Chlorophyceæ, Indo-Pacific, 470
- Choffutella*, A New Locality for, 109
- Chondriome in *Phaseolus*, The, 259
- in the Cells, A New Technique for the Rapid and Certain Demonstration of the, 323
- Chromatids of Homologous Chromosomes, Exchange of, 259
- Chromatophores, 326
- , The Effects of Temperature on, 327
- Chromosomal Constitution of Nubbin *Datura*, 355
- Variation in *Crepis*, 458
- Chromosome Arrangement in *Narcissus* and *Lilium*, 353
- in *Rhæo*, 352
- Association in *Pyrus*, 350
- Circles in *Datura* and *Oenothera*, 355
- Morphology on the Phylogeny of Cereals, The Bearing of, 253
- on the Phylogeny of *Triticum* and *Aegilops*, The Bearing of, 254
- Number and Morphology in *Nicotiana*, 457
- in Apples, Fertility and, 351
- in "Rabbit-eared Rogues" of *Pisum sativum*, 356
- in *Syringa*, 354
- Numbers, 459
- in *Dianthus*, 459
- in *Linum*, 353
- in *Potentilla*, 120
- in *Vitis*, 354
- in Wheat Hybrids, 122
- Ring in *Pisum*, 120
- Structure, 120, 258
- Chromosomes and Phylogeny in *Crepis*, 458
- and Sterility in *Homocallis fulva*, 255

- Chromosomes, Exchange of Chromatids of Homologous, 259
 — in *Aucuba japonica*, 256
 — in Cyperaceæ, 255
 — in *Humulus*, Sex, 353
 — in *Iris*, 258
 — in *Salix* Hybrids, 255
 — in *Sorbypyrus* and *Sorbaronia*, 354
 — in the Hen, Observations on the Number of, 326
 — of *Cucumis*, 459
 — of Dioecious Angiosperms, 120
 — of Reptiles, 234
 — of *Rhododendron*, 354
 — Spiral Structure of, 352
 Ciliate from Sea-Urchins, Intestinal, 452
 — from the Intestine of Earthworms, A New Species of, 346
 Ciliates, A New Silver-Impregnation Method for, 451
 — Excretion of Nitrogen in, 251
 — New Freshwater, 114
 — Observations on Some Freshwater, 112
Citrus Penicillium, 272
 Cladocera Clones derived originally from a Single Mother, A Study of the Rate of Oxygen Consumption of Different, 334
 — Control of Sex in. III. Localisation of the Critical Period for Control of Sex, 331
 — — of Sex in. IV. Relation between the Rate of the Mother's Development and the Sex of her Young, 331
 — — of Sex in. V. Experimentally Accelerated Development of Mothers and Sex of Young; Mammalian Endocrine Substances without Specific Effect on Cladocerans, 332
Cladonia, Deformations in, 483
 — Mats to Soil Moisture, Relation of, 146
Cladonia, American, 482
 — Danish, 278
 — of the Gaspé Peninsula, 374
Cladophora, Reduction Division in, 469
 — Resting Organs of, 470
 Cleistogamous Flowers, Histological and Cytological Researches on, 356
 Coccidia, New Mammalian, 250
 Coccidial Oocysts, Excystation of, 252
 Coccidiosis in Gallinaceous Birds, 343
 Coccids, Gall-Making, 103
 Codling Moth, Reproductive System of the, 444
Coleochaete, 363
 Coleoptera, Australian, 100, 339, 445
 — Biology of Associated, 443
 — New Australian, 240
 — New Species of, 447
 — of France, 237
 Collembola Fauna of Southern India, 238
 — from Abyssinia, 99
 — of Ireland, The, 241
 Conifers, Disease of, 481
 — Morphological Notes on, 263
Coprinus micaceus, Study of, 137
Coptotermes, New Species of, 240
 Coral Reefs, 472
Cordyceps, New Localities for, 272
 Corn, Dry Rot of, 373
Corynosoma strumosum (Rudolphi), from the Californian Harbour Seal, An Acanthocephalan, 450
Cosmocladium, 469
 Cotton Disease, Bacteria of, 277
 — Leaf Disease of, 481
 — Root-Rot, 479
Cotylurus michiganensis (La Rue), Life-Cycle and Description of the Cercaria of, 448
Councilmania, The Status of, 113
 Crane-fly, A New Marine, 445
Crepis, Chromosomal Variation in, 458
 — Chromosomes and Phylogeny in, 458
 — Hybrids, Cytology of, 458
 — Meiosis in, 120
 — Triploidy in, 121
 Cross-sections of Hair, 437
Cucumis, Chromosomes of, 459
 — Meiosis in, 257
 Cucurbitaceæ, Staminate Flower of *Echinocystis* and the Systematic Position of the, 262
 Cup-Fungi, 366, 475
Cupressinoxylon, A New Species of, 462
 Curculionidæ, Immature Forms of, 444
 Cyanophyceæ and Bacteria, 468
 Cyathecaceous Prothallia, 464
Cycloconium, Notes on, 373
Cylindrospermum, Heterocysts of, 469
Cymatopleura, 362
 Cyperaceæ, Chromosomes in, 255
Cypselium, Study of, 280
 Cytological Variations in the Blood of Hens, 327
 Cytoplasmic Sexualization, An Experimental Demonstration of the Laws of, 233
 Cytology of a Dwarf Wheat, Genetics and, 121
 — The Infra-red in, 94
- D
- d'Alzheimer's Method VI for the Neuroglia of the Central Nervous System, A Modification of, 85
 Date Palms, Disease of, 373
Datura and *Oenothera*, Chromosome Circles in, 355
 — Chromosomal Constitution of Nubbin, 355
 — Cryptic Types in, 355
 — Pollen-Tube Growth in, 460
 Delafield's Hamatoxylin and Mallory's Connective Tissue Stain, A Combination of, 231
 Dengue, Experiments on the Virus of, 92
 — Fever, Phlebotomus and, 92
 Desmids from Bavaria, 130
Devescovina from India, New Species of, 112
Dianthus, Chromosome Numbers in, 459
 Diatoms, Ceylon, 267
 — Hyrax, A New Mounting Medium for, 424
 — Origin of, 267

- Diatoms, Sea, 362
 — Spitsbergen, 129
Dicranum Scottianum, 266
Dictyoconoides a Synonym of *Rotalia*, 248
Didinium, Indefinite Reproduction in, 251
 Dinoflagellates, Swarming of, 129
Diococetus (Fuhrrn), Contribution to the Origin of Unisexuality in the Genus, 343
 Diphtheria Bacilli, A Differential Stain for, 439
 — Studied on Embryo Tissues cultivated *in vitro*, Local Immunity against, 234
Diphyllbothrium latum Eggs, Notes on the Hatching of, 448
Diplostomula, Two New Species of, 246
Diplostomulum scheuringi sp. nov. and *D. vegrandis* (La Rue), 246
 Diptera, Australian, 100, 104, 337, 443
 — Morphogenesis in the Muscoid, 103
 Discomycetes, Russian, 272
 Dog Hookworm, *Ancylostoma caninum*, Host-induced Variation in the Growth Curve of the, 450
 — The Effect of Age and Size of Infestation on the Egg Production of the, 449
 — The Influence of Temperature, Hydrogen-ion Concentration, and Oxygen Tension on the Development of the Eggs and Larvæ of the, 450
d'Orbignyan Type Studied, Another, 454
Dorcus parallelipedus L., Morphology of the Larva of, 445
Doryanthes excelsa, Life-History of, 126
Dracunculus medinensis, Contribution to the Knowledge of the Structure of, 245
 Dragon-Flies, Rearing, 338
Drosera, The Vacuum of, 260
Drosophila, Genetic Factors in, 239
 — Rate of Mutability in, 239
 Dry Rot of Corn, 373
Dryptodon, 129
 Dyes in Histology, Anilin, 227
 — in the Cancer Problem, The Application of, 325

E

- Earthworms, A New Species of Ciliate from the Intestine of, 346
Echinocystis, Staminate Flower of, 262
 Echinostome Cercaria from North America, A Large-tailed, 109
Ectocarpus, 131
 Eels from the Rhine, The Otoliths of Small, 420
 Egg-Parasite, A Hymenopterous, 444
 Elms, Disease of, 142
 Embedding Apparatus for Research Workers, An, 218
 — Method, A Rapid Paraffin, 227
 Embryo Tissues cultivated *in vitro*, Local Immunity against Diphtheria Studied on, 234
 Embryological Material, The Sectioning of, 325

- Embryos, A Method for Separating Amphibian, 434
Endamaeba coli, Cultivation of, 451
 Endomixis in *Balanitidum*, 451
 Endophyte of *Calluna*, 141
Endothyra as a Devonian Fossil, 456
 Entomology, Principles of Systematic, 104
 Entomophthoraceæ, 133
 Epiphragm in Streptaxis, The, 235
 Epithelium in the Lungs of Mice, Phagocytosis in the Bronchial, 328
Equisetum, Distribution and Phylogeny of, 464
 — in Spain, 361
 Erysiphe, Perithecial Development in, 271
 Erythrosin Gram-Weigert Stain, A Hæmatoxylin, 231
Euglena, 468
 — Thermotaxis in, 344
 Euglenas, The Muciferous Apparatus and the Vacuum in, 345
 Euglenoid Flagellates, The Cytology of Certain, 114
 Eumolpid Beetles, New Species of, 446
 Euphorbiaceæ, Wood Structure of the, 125
Euplotes, Division and Conjugation in, 452
Exormotheca, 465

F

- Fern Studies, Taxonomic, 360
 Ferns, Galician, 361
 — Kwangsi, 127
 — Punctate, 465
 — Sumatra, 465
 — West Asiatic, 127
 Fibres, The Mounting of Textile, 485
Firmiana simplex Wight, Sex-Differentiation and Flower Anatomy of, 460
Fissidens, Propagules of, 128
 Fissilabioidea, Revision of the, 102
 Fistulous Withers, Parasitism and, 449
 Fixation Images, 124
 — The Effect of pH on, 123
 Flagella and Capsule Stain for Bacteria, 437
 — of the Peridinians, 345
 Petragrani's Method for Bacterial, 88
 Flagellate of the Green-Bottle Fly, A, 344
 Flagellates of Termites, The Oxymonad, 112
 — The Cytology of Certain Euglenoid, 114
 Flemming's Safranin, Gentian Violet, Orange G Method, A Modification of, 89
 Florideæ, British, 471
 — of Poland, 131
 Fœttingeridæ (Ciliates), Pre- and Metapalintomic Metamorphoses in the, 118
 Foraminifera, Atlantic, 347
 — Australian Tertiary, 348
 — Californian, 346
 — Cretaceous, 111
 — Tertiary, 346
 — Faroese, 348
 — from Florida, Fossil, 455
 — from North-East Borneo, Fossil, 111

- Foraminifera from Tennessee, Upper Cretaceous, 249
 — from Texas, Cretaceous, 247
 — from the South Atlantic, Some New, III, 38
 — from Venezuela, Cretaceous, 455
 — from Venezuela, Tertiary, 111
 — Lower Pennsylvanian, 248
 — Mexican Fossil, 248
 — New Jurassic, 346
 — of Sardinia, Miocene, 110
 — of the Plymouth District, I, 46
 — of the Plymouth District, II, 161
 — of the "Siboga" Expedition, 246
 — Philippine, 110
 — Recent Californian, 111, 454
 — Upper Cretaceous, 347, 349
 Foraminiferous Limestone from Sumatra, 110
 Formol, The Influence of the pH in Fixation by, 324
 Fossil, A Cretaceous, 248
 — *Hasteriginella* as a, 247
Fossombronia, 127
 Frog Lung Flukes, The Life-History of Two North American, 447
 — The Effect of Histamine and of Local Injury on the Blood Vessels of the, 235
 Frozen Section Technique, 302
 — Sections, The Rhamy Triple Stain for, 433
 — The Staining of, 433, 434
 Frullaniaceæ of Oceania, 466
 Fungi and Bacteria, Variation in, 275
 — Belgian, 274
 — Biology of Wood, 273
 — Caucasian, 140
 — Cellulose-Decomposing, 478
 — Chinese, 140
 — Congo, 371
 — Distribution of Mould, 474
 — Dominican, 140
 — Effect of Substratum on, 369
 — from Somaliland, 275
 — from Spain, 274
 — from Sumatra, 278
 — from the Congo, 275
 — from Vancouver, 275
 — Glycogen in, 142
 — Massalongo's, 141
 — Metabolism in, 372
 — New British, 478
 — New or Noteworthy, 274, 371
 — of Czechoslovakia, 141
 — of Santo Domingo. III. Uredinales, 367
 — of the Asturias, 478
 — of Venezuela, 371
 — Origin of, 275
 — Panama, 477
 — Saltation in, 372
 — Sex and Nutrition in the, 270
 — Soil, 370
 Fungus, Cherry Leaf-Spot, 374
 — Culture, Studies of, 480
 — Diseases of Crops, 277
 — Flora, 140
 — — of Silesia and Moravia, 477
 Fungus, Human Skin, 277
 — Physiology and Taxonomy, 478
Fusarium on Rye, 481
 — Study of, 135
- G
- Gambusia holbrooki*, Modifications of Chondriosome and Lacunoma in the Intestinal Cells of, 94
 Gametes, Fusion of, 133
 Gametocytes of Tertian Malaria and their Early Appearance in Malaria transmitted by *Anopheles punctipennis*, 118
 Geasters, Dehiscence of, 369
 Gelatine Carmine Injections, 230
 Gelatin Fixative for Paraffin Sections, 435
 Genetic Male Intersex, A Theory of the Significance of the, 441
 Genetics and Cytology of a Dwarf Wheat, 121
 Geometridæ, Australian, 103
 — from French Oceania, 107
 — New African, 102
 Giant Cells in Tubercular Lesions, The Factors determining the Appearance and Frequency of, 234
 Giemsa's Stain, Blood Films Stained with Iron Hæmatoxylin and, 439
 Glandular Secretion, 93
Glaziella, Study of, 473
Gloeotanium, 362
 Glycogen in Fungi, 142
Gmelina Leichhardtii, Vegetative Anatomy of, 124
 Gold and Lead, The Histochemical Detection of, 232
 Golgi Apparatus, A Method for Demonstrating the, 324
 — and Vacuome in the Suprarenal of the Pregnant Guinea-pig, 233
 — in Free-Living Protozoa, The Demonstration of the, 89
 — in *Vicia*, 123
 — The Use of Cadmium Fixation for the Demonstration of the, 323
Gonderia mutans, The Existence of "Grenade Bodies" in the Cycle of Development of, 116
 Gonidia, Lichen, 279
 — Study of, 147
Gonium in Culture, 468
 Gordiidae as Parasites of Man, 109
 Gramineæ, Meiosis in the, 122
 Gram's Method, A Method of Staining Bacteria in Tissues by, 439
Graphium, *Ceratostomella* and, 366
 Grasshopper, Anatomy of the, 236
 Green-Bottle Fly, A Flagellate of the, 344
 Greensands, East Texas, 347
 Grouse-Locusts of Madagascar, 104
 Grubs upon Animal Skin, Some Histological Studies of the Effects of, 378
 Guinea-pig, Golgi Apparatus and Vacuome in the Suprarenal of the Pregnant, 233
 — The Schizogonous Forms of a Sporozoon of the, 116

Gums and Resins, Photographic Estimation of Foreign Materials in, 377
 Gymnophiona from Central India, 342
 Gymnosperms, Vegetative Propagation of, 262
Gymnosporangium, Cytology of, 476

H

Hæmatein, 227
 Hæmatoxylin and Mallory's Connective Tissue Stain, A Combination of Delafield's, 231
 — Erythrosin Gram-Weigert Stain, A, 231
 Hair, Cross-sections of, 437
 Haliplideæ, North American, 338
Hantkenina, Ancestry of, 348
Haplometra Looss, 1889, The Genus, 342
Hasteriginella as a Fossil, 247
 Helicosporeæ, 134
 Helminth Infestations in a Panama Village, A Study of the Influence of the Rainy Season on the Level of, 245
 Helminthological Research in Hamburg.
 1. The Genus *Haplometra* Looss, 1889, 342
 Helminthological Research in Hamburg.
 2. On Two Trematode Parasites of Mammals, 343
 Helminths, Arthropod Hosts of, 102
 — Two New, 342
Hemerocallis, Floral Morphology and Pollen Formation of, 356
 — *fulva*, Chromosomes and Sterility in, 255
 Hen, Observations on the Number of Chromosomes in the, 326
 Hens, Cytological Variations in the Blood of, 327
 Hepaticæ, Oregon, 266
 — Peruvian, 128
 Hepatics, Massalongo's, 128
 Heredity and Longevity, 332
 Hermaphroditism in a Common Indian Frog, *Rana tigrina*, A Case of, 320
 Heterocontæ, Pyrenoids in, 267
Heterophyllum, *Acanthocladiella* and, 466
 Heterothallism in *Pilacre*, 139
 Heterotypic Division in the Pollen Mother-Cells of a Tetraploid Form of *Rumex scutatus* var. *typicus*, Phenomena of, 387
 — Prophases, 259
Hexagonia Spores, Revival of Dried, 139
 Histochemical Detection of Gold and Lead, The, 232
 Histological Method, A Microchemical, 232
 — Studies of the Effects of Grubs upon Animal Skin, 378
 Histophysiology of the Fœtal Annexa in Mammals, 329
 Hookworm, *Ancylostoma braziliense*, Quantitative Studies on the Dog and Cat, 244
 — *Ancylostoma caninum*, especially adapted to the Cat, Experimental Demonstration of a Strain of the Dog, 242

Hookworm, *Ancylostoma caninum*, Further Experiments with Physiological Strains of the Dog, 243
 — Host-induced Variation in the Growth Curve of the Dog, 450
 — Studies of the Blood Changes occurring in Young and Old Dogs during Cutaneous and Oral Infection with the Dog, 244
 — The Effect of Age and Size of Infestation on the Egg Production of the Dog, 449
 — The Influence of Temperature, Hydrogen-ion Concentration, and Oxygen Tension on the Development of the Eggs and Larvæ of the Dog, 450
 — The Length of Life and Rate of Loss of the Dog, 244
 — The Reaction and Susceptibility of Dogs of Different Ages to Cutaneous Infection with the Dog, 243
 — and *Ascaris* in two Villages in Panama, A Study of Reinfection after Treatment with, 242
 — and *Trichostrongylus orientalis* in Keijo, On the Incidence and Degree of Infestation with, 341
 — Larvæ, The Suitability of Various Bacteria as Food for, 242
 Hookworms in their Hosts, The Biology of, 449
 Host, Relation between Parasite and, 274
Humulus, Sex Chromosomes in, 353
 Hydnaceæ, Resupinate, 477
 Hydracarina of the Isle of Bornholm, 341
 Hydras of North America, Studies on the, 109
 Hymenoptera, Central American and West Indian, 103
 Hymenopterous Egg-Parasite, A, 444
 Hyphal Tissue, Study of, 370
 Hyphomycetes, Indian, 367
 Hypogonitism in *Rana cantabrigiensis*, 330
 Hyrax, A New Mounting Medium for Diatoms, 424
Idelopteris, *Psygmorephyllum* and, 264
 Illumination of Metallurgical Specimens, 319
 Illuminator, The Wrighton-Beck Metallurgical, 148
 Images, Fixation, 124
 — The Effect of pH on Fixation, 123
 Immersion Oil, Anisol in Place of Cedar Oil for, 88
 Infra-red in Cytology, 94
 Insect Parasites, New, 241
 Insects as Disease Carriers, 372
 — in Relation to Potato Virus Diseases, 335
 — New, 236
 — The Peritrophic Membrane in, 335
 Interferometry, The Measurement of Spherical Aberration in High Numerical Aperture Objectives by, 307

- Iodine, Algæ and, 472
Iresine, Experimental Grafts between
Solanum and, 359
Iris, Chromosomes in, 258
— *Kämpferi*, Meiosis in, 258
Iron Hæmatoxylin and Giemsa's Stain,
Blood Films Stained with, 439
— Pigment, The Role of Mitochondria in
the Formation of, 233

J

- Juncus*, *Ustilago* on, 137

K

- Kittens, Intestinal Amœbiasis in, 117

L

- Lakes, Norwegian, 363
Larix, The Geographical Distribution of,
463
Larva of *Dorcus parallelopipedus* L.,
Morphology of the, 445
Larvæ, Development of Amphibian, 96
— of *Ambystoma maculatum*, 329
Lathyrus, Meiosis in, 351
Lead, The Histochemical Detection of
Gold and, 232
Leaf Disease of Cotton, 481
— Habit, Vascular Variation due to, 358
Leaf-Spot of Chestnut and Oak, Large, 142
Leguminosæ, *Ascochyta* on, 135
Leishmania-like Phase in the Develop-
ment of *T. vivax-cazalboni* and *T.*
congolense-dimorphon in the Verte-
brate Host (bovines), 115
Lepidocyclina from Sumatra, A New, 111
Lepidoptera, New Australian, 445
— New Sense Organ in, 101
— Scent-Organs of, 99
Lepidosiren, Vascular Filaments of, 96
Lepisma domestica, X-Radiation and the
Spermatogenesis of, 90
Leucocytozoa, Observations on, 113
Leukæmia in Mice, 440
Lichen Development, 283
— Flora of Bohemia, 145
— Galls, 146
— Genera, New, 144, 280
— Genus, New, 144
— Gonidia, 279
— Vegetation of Poland, 375
Lichenological Contributions, II, 144
— Notes, 483
Lichens, 282
— Abyssinian, 374
— as Indicators of Climate, 147
— Bulgarian, 145
— Classification of, 283
— Eastern, 282
— from Alaska, 281
— from Italian Somaliland, 280
— from Porto Rico, 281
— Further Hungarian, 144

- Lichens, Hungarian, 144
— Kamtschatka, 146
— Mexican, 375
— Moraine, 281
— Northern, 282
— Notes on, 483
— of a Town Neighbourhood, 484
— of Bohemia, 145
— of Czechoslovakia, 482
— of Moravia, 145
— of Porto Rico, 483
— of Suffolk, 482
— of the Jura, 483
— of the Tatra, 145
— of the Tauern Hills, 143
— of the Tundra, 142
— of the Volga and the Ural, 374
— Official, 282
— New Italian, 278
— Russian, 483
— Silesian, 375
— Somerset, 282
— Swiss, 144, 281
— Symbiotic System of, 283
— Systematic Notes on, 281
Lichina, Distribution of, 376
Lilium, Chromosome Arrangement in
Narcissus and, 353
Limestones in South Africa, Upper Eocene,
455
Limnæa and *Bulinus*, The Radula of, 97
Lindsaya, 360
Linum, Chromosome Numbers in, 353
Lituolids from Shallow Water, Some, 249
Lola lubrica, 130
Longevity, Heredity and, 332
Lumbricus terrestris L., Some Abnormali-
ties in the Earthworm, 108

M

- Macrocorixa geoffroyi*, Oxyhæmoglobin in,
99
Macrophomina Cultures, 272
Malaria and their Early Appearance in
Malaria transmitted by *Anopheles*
punctipennis, The Gametocytes of
Tertian, 118
— Selection and Susceptibility to Bird, 343
Mallory's Connective Tissue Stain, A Com-
bination of Delafield's Hæmatoxylin
and, 231
Mammalian Egg, The Size of the, 93
Mammals, The Histophysiology of the
Fœtal Annexa in, 329
Mansonia, Brazilian Species of, 238
Mantids, Two Rare, 238
Maple Leaf Disease, 480
Marchantia, 127
— and *Plagiochasma*, 465
Marine Crane-fly, A New, 445
Massalongo's Fungi, 141
— Hepatics, 128
Mayer's Hemalum, A Modification of, 86
Mayorella bigemma, The Status of, 113
Meiosis and Syndesis in *Oenothera*, 355
— in *Rhæo*, 352
— in Alfalfa, 356

- Meiosis in *Oreopsis*, 120
 — in Hybrids of *Aegilops*, 350
 — in *Iris Kämpfersi*, 258
 — in *Lathyrus*, 351
 — in *Narcissus*, 353
 — in Strains of *Oenothera Lamarckiana*, 254
 — in the Gramineæ, 122
 — in *Triticum* and *Aegilops* Hybrids, 253
 Meliaceæ, Histological Studies in the, 261
 Mercuric Chloride on the Eggs of *Arbacia*, The Effects of, 327
Mesembryanthemum, Seedling Anatomy of, 261
Mesoxylon platypodium and *Mesoxylodes*, 462
 Metabolism in Fungi, 372
 Metallography at Low Temperatures, 316
 Metallurgical Illuminator, The Wrighton-Beck, 148
 — Microscope, Beck-Hadfield, 485
 — — The No. 30 Inverted, 489
 — Specimens, Illumination of, 319
 Mice, Leukæmia in, 440
 — Phagocytosis in the Bronchial Epithelium in the Lungs of, 328
 Microchemical Histological Method, A, 232
 Microfungi, American, 141
 Micrograph, The Origin of a Reflex, 376
 Micro-Incineration Method, The, 436
Microlepidoptera, Genetic Names of, 104
 Microscope, Beck-Hadfield Metallurgical, 485
 — Hot Stage, A New, 377
 Lamp, A, 34
 — New Model Vickers Projection, 378
 — Sections of Whole Organs Embedded in Paraffin, Notes on the Preparation by Cheate's Method of Thin, 200
 — The No. 30 Inverted Metallurgical, 489
 Microscopes by James Smith, Early Achromatic, 297
 Microscopic Sections, Localising Inorganic Substances in, 436
 Microscopical Methods in Analytical Chemistry, 377
 — Objects, An Optical Instrument for the Projection of Images of, 30
 — Studies in Pernicious Anæmia, 427
 Microscopy, Resolution and Visibility in Medical, 1
 — Simplified Apparatus for Ultra-violet, 284
 Migrants, Suez Canal, 364
 Mite, The Scrub Itch, 447
 Mitochondria, A New Fixative for, 229
 — from the Nucleus of the Glandular Cells of the Vas deferens of the Armadillo, The Formation of, 234
 — in a Sporozoon, 327
 — in the Formation of Iron Pigment, The Role of, 233
 Mitosis in Tissue Culture, The Behaviour of the Nucleolus during, 326
Moina macrocopa, Growth and Maturation in the Parthenogenetic and Sexual Eggs of, 329
 Molluscs in *Ascophyllum*, 132
 Molluscs of the Indawgyi Lake and of the Connected Freshwater Areas in the Myitkyina District, Burma, The Freshwater and Amphibious Gastropod, 334
 Moors, Subarctic, 362
 Mosquitoes and Algae, 267
 Moss Mites as Spore-Bearers, 276
 Mosses, American, 361
 — Ceylon, 361
 — Congo, 467
 — Himalayan, 266
 — of Morocco, 362
 — South African, 129
 — Waziristan, 266
 Moth, Reproductive System of the Codling, 444
 Mounting, Modification of Berlese's, 106
 Mounting of Textile Fibres, The, 485
 Mouse, A New Mutation of the House, 235
 Mucin, The Demonstration of, 228
 Mucor, Genetics of, 269
 Mucorini, New, 473
 Muscoid Diptera, Morphogenesis in the, 103
 Mushroom Culture, 138, 479
 — Disease, 373
 Mussels, Sex in, 235
 Mycetophilidæ, Australian, 240
 Mycetozoa, American, 484
 — from Poland, 284
 — New Genus of, 484
 — Sclerotia of, 283
 Mycological Notes, 140, 478
 Mycology, American, 479
 — Italian, 139
 — Medical, 479
 — Russian, 274
 Mycorrhiza, Notes on, 275
 — of the Alder, 276
Mysorella costigera Kuster, Anatomy of, 334
 Myxobacteria, 482
 Myxomatosis of Rabbits, Infectious, 91
 Myxomycetes, Spores of, 147
 Myxosporidia, New, 113

N

- Narcissus* and *Lilium*, Chromosome Arrangement in, 353
Narcissus, Meiosis in, 353
 Negri Bodies, A Rapid Method for the Colouration of, 229
 — — Staining of, 87
 Nemathelminthes found in the Tissues of Man in Rio de Janeiro, Erratic and Wandering, 243
 Nematode Family Acuariidæ seurat, 1913, On a New Genus of the, 449
 — Parasites of the Guillemot, Two, 342
 Nematodes, A Histological Technique for the Serial Sectioning of Small, 324
 — from Indian Hosts, Two New Species of, 245
 — from Yucatan (Mexico), including a New Genus of Strongyle from Cattle, Some New Parasitic, 243

- Nematodes occurring in Arable Soil in the North of Scotland, Free-living, 243
- Nematospira*, New, 480
- Nerve Fibres, The Silver Impregnation of, 438
- Nervous System, A Modification of d'Alzheimer's Method VI for the Neuroglia of the Central, 85
- Neurofibrils, A Silver Impregnation Method for, 228
- Neuroglia of the Central Nervous System, A Modification of d'Alzheimer's Method VI for the, 85
- The Staining of, 231
- Neuroptera, Oriental, 237
- Neutral Red and of the Pyronins, The Analysis of, 436
- Newt, A Trypanosome of the, 114
- Nicotiana*, Chromosome Number and Morphology in, 457
- X-Radiation of, 457
- Norwegian Lakes, 363
- Notocotylus attenuatus* Rud., 448
- Nubbin *Datura*, Chromosomal Constitution of, 355
- Nucleolus during Mitosis in Tissue Culture, The Behaviour of the, 326
- Nyctotherus*, The Genus, 345
- O
- Oak, Large Leaf-Spot of Chestnut and, 142
- Oat Smuts, Study of, 273
- Objectives by Interferometry, The Measurement of Spherical Aberration in High Numerical Aperture, 307
- Ochrosphaera*, 362
- Odonata, Gynandromorphism in, 101
- Oedogonium*, 470
- Fertilization, 470
- Oenochromidæ, Australian, 336
- Revision of Australian, 442
- Oenothera*, Chromosome Circles in *Datura* and, 355
- Meiosis and Syndesis in, 355
- Segmental Interchange in, 355
- *Lamarckiana*, Meiosis in Strains of, 254
- *rubricalyx*, Megaspore Development in, 254
- Oligodendroglia of the Optic Tracts, New Observations on the, 328
- Oocysts, Excystation of Coccidial, 252
- Ortalidæ, Australian, 240
- Orthodicranum Allorgeri*, 466
- "Osmic Acid," with some Applications to Cytological Technique, A Simple Method for Estimating, 221
- Osmunda*, 265
- Ostrea cucullata*, On the Origin of Yolk in the Egg of, 210
- Otoliths of Small Eels from the Rhine, The, 420
- Palaequium*, Identification of Ceylon Species of, 261
- Panulirus japonicus* (v. Siebold), Development of the Spiny Lobster, 98
- Paraffin Embedding Method, A Rapid, 227
- Method for Tissue Sections, A Rapid, 434
- Sections, A Gelatin Fixative for, 435
- Parasite and Host, Relation between, 274
- Saprolegniaceae, 133
- *Trametes* as a, 477
- Parasites of Mammals, On Two Trematode, 343
- of *Tapirus americanus*, Contribution to the Knowledge of the Strongyloidea, 245
- of the Guillemot, Two Nematode, 342
- Studies on Japanese Amphistomatous, 341
- Parasitism and Fistulous Withers, 449
- Physiology of, 371, 372, 480
- Paschen Bodies, The Staining of, 434
- Patellina* in the North Pacific, 110
- The Genus, 247
- Pathogenicity, Study of, 137
- Puccinia* Species, New, 476
- Peltigeræ, Acharian, 483
- Penicillia, 367
- Penicillium*, *Citrus*, 272
- Peridinians, The Flagella of the, 345
- Peridinium*, The Structure of, 345
- Periphykon*, 472
- Periplaneta americana*, The "Rickettsia" of, 91
- Peronosporæ, Roumanian, 473
- Peronosporaceæ, Cytology of, 133
- Peroxydase-Wright's Stain for Blood Films, A Combined, 436
- Petragnani's Method for Bacterial Flagella, 88
- Pezizella*, Fructifications of *Chaetomella* and, 367
- Phæophyceæ, Physodes of, 268
- Phæosporeæ, 131
- Development of, 132
- Phagocytosis by Bronchial Epithelium in the Lungs of Mice, 328
- Phalloid from Palestine, 139
- Phaseolus*, The Chondriome in, 259
- Phlebotomus*, A New Species of, 340
- and Dengue Fever, 92
- *nicnic* Banks, Notes on, 340
- Photomicrography with Incident Light, A Simple Apparatus for, 90
- Phyllophora* and *Actinococcus*, 130
- Phyllosticta* on Chick-Pea, 482
- Phylogeny, Anatomical and Cytological Studies in, 358
- of Cereals, The Bearing of Chromosome Morphology on the, 253
- of *Triticum* and *Aegilops*, The Bearing of Chromosome Morphology on the, 254
- Phytophthora, Differential Growth of, 475
- Study of, 269
- Picea stichensis*, Variation in Tracheid Length in, 358

Fig. A Tricercomonas of the, 116
Pilacre, Heterothallism in, 139
 Pineapple, The Seedling and Young Plant of the, 462
 Pines, Chinese, 463
 Piropasma seen in Poultry in Egypt, A, 115
Pisum, Chromosome Ring in, 120
 — *sativum*, Chromosome Number in "Rabbit-eared Rogues" of, 356
Plagiochasma, *Marchantia* and, 465
Plagioclila, Antheridia of, 128
 Plankton, Wharfe, 468
 Plant Disease, Bacterial, 277
 — Diseases in Colombia, 142
 Plants, Pollen-Grains in Identification and Classification of, 460
Plasmodiophora, Study of, 284
 Plasmodiophoraceae, New, 485
 Plecoptera, New, 339
Plenodomus, New Species of, 474
Plicatula, The Anatomy of, 235
 Polar Bodies in Bacteria, The Staining of, 439
 Pollen-Grains in Identification and Classification of Plants, 460
 Polypodiaceae, Genera of, 359
Polytrichum, Peristome of, 265
 Poncephalide, Life-History Studies on the Trematode Family, 246
 Porcupine, A Trichomonas of the, 115
 Poricidal Anthers, The Structure of, 264
Porina Species, 143
 Potato Virus Diseases, Insects in Relation to, 335
Potentilla, Chromosome Numbers in, 120
 Poultry, Balfour Bodies in the Blood of, 117
 Presidential Address: Resolution and Visibility in Medical Microscopy, I
 Privet Anthracnose, 277
 Prociliata, Evolutionary Significance of the, 250
 Projection Apparatus in Anatomical Studies, Use of the, 359
 — Microscope, New Model Vickers, 378
 Projectograph, The, 30
 Propagation of Gymnosperms, Vegetative, 262
 — Vegetative, 262
 Propagules of *Fissidens*, 128
 Prothallia, Cyatheaceous, 464
 Protoplasm of Algae, 467
 Protoplasmic Viscosity and Biological Reactions, 326
 Protozoa, A Method for Concentrating and Sectioning, 324
 — The Demonstration of the Golgi Apparatus in Free-Living, 89
Prunus, Polyploidy in, 256
 Pseudoparenchyma, Formation of, 370
Psilotum, A Tetraploid, 123
Peygmyphyllum and *Idelopteris*, 264
 Pteridophytes of Lettland, 265
 — of Thuringia, 127
Puccinia, A New, 136
 — *mirabilissima*, 368
 Pyrales, Pacific, 107
 Pyrenoids in Heterocontae, 267

Pyrenomycetes, Hawaiian, 134
Pyrgotidae, Australian, 100
 Pyronins, The Analysis of Neutral Red and of the, 436
Pyrus, Chromosome Association in, 350
Pythium, Studies of, 365

R

Rabbit, Experimental Typhus in the, 441
 Rabbits, Infectious Myxomatosis of, 91
 Races, Are there Genetically-Based Differences between the? 333
 — Biological, 442
Radula of *Limnæa* and *Bulinus*, 97
Rana cantabrigensis, A New Case of Intersexuality in, 235, 330
 — — Hypogenitalism in, 330
 — — Intersexuality in, 333
 — — Intersexuality in Tadpoles of, 333
 — *tigrina* Daud, A Case of Hermaphroditism in a Common Indian Frog, 320
 Recapitulation Theory and Biochemistry, The, 329
 Reflex Micrograph, The Origin of a, 376
 Reptiles, Chromosomes of, 234
 Resins, Photographic Estimation of Foreign Materials in Gums and, 377
 Resupinate Hydnaceae, 477
Rhacomitrium sudeticum, 466
 Rhamy Triple Stain for Frozen Sections, 433
Rhizoctonia Disease, 481
Rhizomorpha melolonthæ, 367
 Rhizopoda from Faeroes, Freshwater, 349
Rhododendron, Chromosomes of, 354
 — Cork Formation in, 260
Rhæo, Chromosome Arrangement in, 352
 — Meiosis and Syndesis in, 352
 Rhopalocera, African, 101
 Rickettsia Diseases, Filterable Viruses and, 91
 "Rickettsia" of *Periplaneta americana*, The, 91
 Ringdoves, The Inheritance of Thyroid Size and the Establishment of Thyroid Races in, 96
 Root-Rot, Cotton, 479
 Roses, Cytological Studies of North American, 257
Rotalia, *Dictyoconoides*, a Synonym of, 248
 — Life-History of a, 454
 Roundworms, New Technique for Collecting Intestinal, 341
Rumex, Cytology of Intersexual Plants of, 459
 — *scutatus* var. *typicus*, Phenomena of Heterotypic Division in the Pollen Mother-Cells of a Tetraploid Form of, 387
Russula, Notes on, 139, 368, 369
 — *adusta* and *R. albonigra*, 369
 Rust-Fungi New to Japan, 476
 Rusts, Epidemiology of Stem, 136
 Rye Disease, 276
 — *Fusarium* on, 481

- Saccoblastia*, Study of, 273
 Safranin Differentiation, 436
Sagrina (?) *tessalata* Brady, 347
Salix Hybrids, Chromosomes in, 255
 Salt Lakes of Steppes, 268
 Saltation in Fungi, 372
 Saprolegniaceous Parasite, 133
 Sarcosporidia in Korean Cattle, A Study of, 116
 — The, 343
 Saw-Fly, Observations on the Oogenesis of the, 335
Saxidomus giganteus, The Butter Clam, 97
 Scapania, American, 466
Schistidium, 128
Schistostega, 128
Schizaea, 126, 360
Sciara are Due to Selective Elimination of Gametes (Sperms), Evidence that "Unisexual" Progenies in, 95
 — (Diptera), Chromosome Behaviour and Genetic Behaviour in, 94
 — — Evidence that the Female is Responsible for the Sex Ratio in, 95
 — — Genetic Identification of the Sex Chromosomes in, 95
 — — Observations on Sex Ratio Determination in, 95
 — Sex Determination in, 338
 — Unisexual Progenies and the Sex Chromosome Mechanism in, 332
Sclerospora from Fiji, New, 133
 Sclerotia of Mycetozoa, 283
 "Scrub Itch Mite," The, 447
Scytonema, 468
See-Urchins, Intestinal Ciliate from, 452
 Section Technique, Frozen, 302
 Sectioning of Embryological Material, The, 325
 — of Small Nematodes, A Histological Technique for the Serial, 324
 — Protozoa, A Method for Concentrating and, 324
 Sections of Whole Organs Embedded in Paraffin, Notes on the Preparation by Cheate's Method of Thin Microscope, 200
 Seedlings, Anatomy of Teratological, 359
 — X-rays on, 351
Selaginella, Hybridism in, 464
 Sexualization, An Experimental Demonstration of the Laws of Cytoplasmic, 233
 Sheep by the Bont-Tick, The Transmission of Heart-Water of, 328
 Silica on the Growth "in vitro" of Cultures of Pulmonary Cells, The Effect of, 92
 Silver-Impregnation Method for Ciliates, A New, 451
 Silver Impregnation Method for Neurofibrils, 228
 — — of Nerve Fibres, 438
 Snowberry, Anthracnose of, 374
 Soil Moisture, Relation of *Cladonia* Mats to, 146
Solanum and *Iresine*, Experimental Grafts between, 359
Sorbopyrus and *Sorbaronia*, Chromosomes in, 354
Sorghum, Smut of, 272
 Spermatogenesis of *Abraxas*, X-Radiation and the, 90
 — of *Lepisma domestica*, X-Radiation and the, 90
Sphaerium, The Anatomy and Life-History of a Freshwater Mollusc of the Genus, 97
 Sphagnaceæ of Archangel, 266
 Sphegidae, Bucco-Pharyngeal Organs of, 340
 Spherical Aberration in High Numerical Aperture Objectives by Interferometry, The Measurement of, 307
 Spiders, Tasmanian, 340
 Spiral Vessels, Formation of Tyloses and Obliteration of, 461
 Spirochetes, A Simple Method for Staining, 229
Spirogyra fluviatilis, 470
Splachnum, 266
Spondylus, The Central Nervous System of, 236
 Spore-Bearers, Moss Mites as, 276
 Spores, Germination of, 134
 — of Myxomycetes, 147
 — Revival of Dried *Hexagonia*, 139
Sporobolomycetes, 366
 Sporozoon, Mitochondria in a, 327
 — of the Guinea-pig, The Schizogonous Forms of a, 116
 Sporulation, Violet Rays and, 372
 Stage, A New Microscope Hot, 377
Stagonospora, Notes on, 373
 Stain, A Combination of Delafield's Hæmatoxylin and Mallory's Connective Tissue, 231
 — A Hæmatoxylin Erythrosin Gram-Weigert, 231
 — Blood Films Stained with Iron Hæmatoxylin and Giemsa's, 439
 — Combined, A Nuclear and Differential, 89
 — for *B. lepro* and Myelin Sheath, 230
 — for Bacteria, A Flagella and Capsule, 437
 — for Blood Films, A Combined Peroxydase-Wright's, 436
 — for Connective Tissue, A Differential, 325
 — for Diphtheria Bacilli, A Differential, 439
 — for Frozen Sections, The Rhamy Triple, 433
 — Weigert's Elastic Tissue, 228
 Stains, Absorption Ratios of Biological, 326
 Staining, A Method of Contact, 87
 — Bacteria in Tissues by Gram's Method, A Method of, 439
 — Character of Bacteria, Variations in, 86
 — Differential, 276
 — Methods, The Development of Bacteriological, 325

- Staining of Animal Tissues, Petraghani's Method for Bacterial Flagella and its Application to the, 88
 — of Brain Tissue, Differential, 87
 — of Frozen Sections, 433, 434
 — of Negri Bodies, 87
 — of Neuroglia, The, 231
 — of Paschen Bodies, 434
 — of Polar Bodies in Bacteria, 439
 — of Tissue Sections, Practical Hints on Azur II-Eosin, 88
 — Reagent, Silver as a, 85
 — Spirochetes, A Simple Method for, 229
 — The History of, 227
 — The Mechanism of, 228
 — The Use of an Alizarin-Molybdic Acid Lake in, 433
 — The Use of Buffers in, 435
 — Vital, 435
 — with Aceto-Carmine, Permanent, 439
 — Chloroform and Acid, 437
 Stem-Rusts, Epidemiology of, 136
Stentor, Nucleus-plasma Relation in, 251
 Steppes, Algæ of, 268
 — Salt Lakes of, 268
 Stereaceæ, Monograph of, 369
Stereocaulon, 280
Sterigmatocystis basidiosepta n. sp., 135
Sterrococcus, *Actinococcus* and, 471
Stigmuria, 264
 Stigonemaceæ, 468
Streblomastix, Morphology of, 344
 Streptaxis, The Epiphragm in, 235
 Strigeidæ (Holostomidæ), Studies on the Trematode Family, No. XIV. Two New Species of *Diplostomula*, 246
 — Studies on the Trematode Family, No. XIX. *Diplostomulum scheuringi*, sp. nov. and *D. vegrandis* (La Rue), 246
 — Studies on the Trematode Family, No. XXI. Life-Cycle and Description of the Cercaria of *Cotylurus michiganensis* (La Rue), 448
 Strongyle from Cattle, Some New Parasitic Nematodes from Yucatan (Mexico), including a New Genus of, 243
 Strongyloidea Parasites of *Tapirus americanus*, Contribution to the Knowledge of the, 245
 Subarctic Moors, 362
 Suez Canal Migrants, 364
Synchytrium, 364
 — *endobioticum* (Schilb.) Perc., Additional Hosts of, 269
 Synthesis in *Oenothera*, Meiosis and, 355
 — in *Rhæo*, Meiosis and, 352
Syniopsis, 265
Syringa, Chromosome Number in, 354
 Technique for the Rapid and Certain Demonstration of the Chondriome in the Cells, A New, 323
 — Frozen Section, 302
Teleasina, Australian, 337
Teloschistes, Study of, 280
 Teratological Seedlings, Anatomy of, 359
 Termite-Flagellates, Effect of Starvation on, 344
 Termite, Sense Organs of the, 446
 Termites, Philippine, 337
 — The Oxymonad Flagellates of, 112
 Tetraploid Form of *Rumex scutatus* var. *typicus*, Phenomena of Heterotypic Division in the Pollen Mother-Cells of a, 387
 Textile Fibres, The Mounting of, 485
 Thallophytes, Reproduction in, 141
 Thermotaxis in *Euglena*, 344
Thielavia, Study of, 480
 Thrips, New Species of Australian, 445
 Thymeleaceæ, Anatomy of the, 359
 Thyroid and Growth, 96
 — Gland and Tracheal Mucosa in Vitamin A Deficiency, The, 233
 — Glands of Cats, Variation in the, 328
 — Size and the Establishment of Thyroid Races in Ringdoves, The Inheritance of, 96
 Thysanoptera, Australian, 107
 Timbers, Use of the Projection Apparatus in Anatomical Studies of, 359
 Tintinninea, A Revision of the, 453
Tipula paludosa, Meig., and *Tipula lateralis*, Meig., On the Final Larval Instar of, 236
 Tipulidæ from Eastern Asia, 337
 Tissue, A Differential Stain for Connective, 325
 — Culture, The Behaviour of the Nucleolus during Mitosis in, 326
 — The Morphology of Liver Cells grown in, 92
 — Cultures in Hanging Drops, A Technique for, 89
 — — Slowing and Experimental Arrest of Growth in, 233
 — of the Pregnant Uterus, The Connective, 328
 — Sections, A Rapid Paraffin Method for, 434
 — — Practical Hints on Azur II-Eosin Staining of, 88
 — Stain, A Combination of Delafield's Hæmatoxylin and Mallory's Connective, 231
 — — Weigert's Elastic, 228
 — Study of Hyphal, 370
 Tissues, A Method for the Prevention of Distortion and Hardening of, 227
 — A Rapid Frozen Section Method for Fresh, 231
 — by Gram's Method, A Method of Staining Bacteria in, 439
 — Cultivated *in vitro*, Local immunity against Diphtheria Studied on Embryo, 234
 — — *in vitro*, The Fixation of Antibodies by, 234

- Tissues, Microchemical Reactions of Woody, 125
Torquatella, with a Description of *Torquatella crotophaga* sp. nov., Revision of the Nematode Genus, 449
 Tracheal Mucosa in Vitamin A Deficiency, The Thyroid Gland and, 233
Trametes as a Parasite, 477
 Tree-hoppers, Ants and, 238
 Tree Limit deducted from Pollen Analysis, Changes in the Upper, 357
 Trees, Influence of *Usnea* sp. on, 282
 Trematode Family Bucephalidae, 108
 — — Bucephalidae, Life-History Studies on the, No. 2, 342
 — — Poncephalidae, Life-History Studies on the, 246
 — — Strigeidae (Holostomidae), Studies on the, No. XIV. Two New Species of *Diplostomula*, 246
 — — Strigeidae (Holostomidae), Studies on the, No. XIX. *Diplostomulum scheuringi* sp. nov. and *D. vegrandis* (La Rue), 246
 — — Strigeidae (Holostomidae), Studies on the, No. XXI. Life-Cycle and Description of the Cercaria of *Cotylurus michiganensis* (La Rue), 448
 — of the Family Notocotylidae Lühe (*Notocotylus attenuatus* Rud.), On the Developmental Cycle of a, 448
 — Parasites of Mammals, on Two, 343
 Trematodes, An Analysis of the Methods used in the Study of Larval, 342
 — Brief Notes on New, No. 2, 246
 — Brief Notes on New, No. 3, 342
 — from the Biliary Ducts of Birds from Armenia, Two New, 448
 Tricercomonas of the Pig, A, 116
Trichoglossum, A New, 271
 Trichomonas of the Porcupine, A, 115
Trichostrongylus orientalis in Keijo, On the Incidence and Degree of Infestation with Hookworm and, 341
Trichuris, with a Description of a New Species, *Trichuris tenuis*, from a Camel, Specific Characters in the Genus, 449
 Triploidy in *Crepis*, 121
Triticum and *Aegilops* Hybrids, Meiosis in, 253
 — — The Bearing of Chromosome Morphology on the Phylogeny of, 254
 Truffle, A New, 475
Trypanosoma cruzi, A Neurotropic Strain of, 118
 Trypanosome of the Newt, A, 114
 Trypanosomes, Blood Picture in Cats infected with, 249
 — without Blepharoplasts, Agglomeration of, 119
 Trypanosomiasis of Camels in Cyrenaica, 118
 Tsetse-Fly, Digestion in the, 236
 Tubercle Bacilli in Sections at Low Temperatures, The Decolourization of, 230
 Tubercular Lesions, The Factors determining the Appearance and Frequency of Giant Cells in, 234
 Tyloses and Obliteration of Spiral Vessels, Formation of, 461
 Types, A bas le culte des, 340
Typhula graminum, Study of, 480
 Typhus in the Rabbit, Experimental, 441
- U
- Udotea*, 471
 Ultra-violet Microscopy, Simplified Apparatus for, 284
 Umbilicariaceae, Study of, 146
Urocyathus oxyurus (Gray), 342
 Uredinales, 367
 Uredineae, Notes on French, 136
 — Study of, 368
Urocystis, A New, 368
Uromyces Scillarum, Study of, 476
Uropyxis mirabilissima in Germany, 136
Usnea, Red Species of, 484
 — sp. on Trees, Influence of, 282
 Ustilaginales, I, Notes on Pennsylvanian, 273
 — on *Andropogon*, 368
Ustilago, New German, 136
 — on *Juncus*, 137
 — Sexuality in, 136
 — Spores, Study of, 476
 — *Zeae*, Study of, 273
 Uterus, The Connective Tissue of the Pregnant, 328
Uvigerina pigmea d'Orbigny, 454
- Vaccine Virus, Survival of, 91
 Vascular Variation due to Leaf Habit, 358
 Vegetative Propagation, 262
 — — of Gymnosperms, 262
Verrucaria, Thallus of, 278
 Vessel, Origin of the, 261
Vicia, Configuration of Gemini of, 351
 — Golgi Apparatus in, 123
 Vickers Projection Microscope, New Model, 378
 Violet Rays and Sporulation, 372
 Virus of Dengue, Experiments on the, 92
 Viruses and Rickettsia Diseases, Filterable, 91
 Viscosity and Biological Reactions, Protoplasmic, 326
 Vital Staining, 435
Vitis, Chromosome Numbers in, 354
- W
- Wasps from the South Australian Museum, Chalcid, 445
 Water-Mites, Philippine, 340
 Weigert's Elastic Tissue Stain, 228
 Wheat, Genetics and Cytology of a Dwarf, 121

- Wheat Hybrids, Chromosome Numbers in, 122
- Wood Vessels, Rate of Flow in Models of, 358
- Woods, Anatomical Structure of Tropical, 261
- from the Tertiary of Japan, Fossil Coniferous, 261
- Woody Tissues, Microchemical Reactions of, 125
- Wrighton-Beck Metallurgical Illuminator, 148
- X-Radiation and the Spermatogenesis of *Abraxas*, 90
- X-Radiation and the Spermatogenesis of *Lepisma domestica*, 90
- of *Nicotiana*, 457
- X-rays on Seedlings, 351
- Y
- Yeast, A Wild, 134
- Zea Mays*, Asynapsis in, 459
- Zone-markers in the Spanish Eocene, 109
- Zygnemales, 469

INDEX OF AUTHORS.

	PAGE		PAGE
ACKERT, J. E.	341, 449	BARTOO, D. R.	126, 360
AGGÍRY, M.	373	BEADLE, G. W.	459
ALEXANDER, C. I.	247	BECK, C.	319
ALEXANDER, C. P.	337, 442	BECKWITH, A. M.	139
ALEXANDROVA, O. G.	461	BEELI, M.	275, 371, 478
ALEXANDROVA, W. G.	461	BEERS, C. D.	251
ALLEN, A. F.	374	BELL, A. F.	372
ALLEN, B. M.	96	BERRY, W.	249, 347
ALLEN, E.	329	BERTRAND, I.	94
ALLMAN, S. L.	444	BERTREM, J. G.	142
ALLORGE, P.	467	BEXON, D.	359
ALSTON, A. M. G.	261	BEZZI, M.	100
AMBROGI, L. P.	227	BHADURI, J. L. . . .	330
AMDUR, I.	377	BHARADWAJA, Y.	468
AMMAN, J.	362	BLAKESLEE, A. F.	269, 355, 460
ANDERS, J.	145	BLANC, G.	92
ANDERSON, E. N.	127	BLECHMANN, M.	234
ANDREWS, E. A.	238, 241, 252	BLOCHWITZ, A.	474
ANDREWS, J.	242, 250, 252	BLOOMER, H.	235
ANDRJSKY, P.	117	BOEDIJN, K. B.	278, 473
ANNAND, P. N.	106	BØRGESEN, F.	364, 472, 473
AOYAMA, F.	323	BORNHAGEN, H.	266
ARWIDSSON, T.	132	BOSE, S. R.	139, 273, 477
ASHFORD, B. K.	367	BOUCHARLAT, M.	92
ASHFORD, B. R.	277	BOWEN, P. R.	480
ASHNER, M.	92	BOWEN, R. H.	93
ATKINS, D.	133	BRADLEY, W. H.	130
AUGUSTINE, D. L.	244	BRANDZA, M.	283
AVERY, P.	457	BRICE, A. T.	436
		BRIERLEY, W. B.	275
BABCOCK, E. B.	120, 458	BRILMYER, G. J.	89, 231
BACHMANN, E. 138, 143, 146, 278, 483		BRINDLEY, M. D. H.	99
BADIAN, J.	482	BROWN, C. R.	105
BAER, J. G.	342	BROWN, L. A.	331, 332
BAGNALL, R. S.	107	BRYAN, G. S.	128
BAILEY, A. A.	372	BUBENAITE, J.	324
BAILEY, H. D.	437	BUCHHOLZ, J. T.	460
BALL, G. H.	450	BUGNION, E.	340
BALZER, U.	481	BUNTEN, I.	356
BAND, M.	439	BURNSIDE, L. H.	251
BANTA, A. M.	329, 331, 334	BURT, D. R. R.	441
BARNARD, J. E.	1		
BARON, C. M.	260, 262	CADEDU, A.	118
BARRETT, R. E.	444	CALZAVARA, E.	94

	PAGE		PAGE
CAMERON, D. R.	122	CRAIG-BENNETT, A.	218
CAMINOPETROS, J.	92	CRANE, M. B.	351
CAMPBELL, A. S.	453	CRESFIN, I.	348
CAMPBELL, H.	230	CUNNINGHAM, J. T.	96
CAMPOS, E. DE S.	118	CURASSON, G.	117
CARPANO, M.	115	CUSHMAN, J. A.	111, 247, 346, 347, 348, 349, 454, 455
CARREL, A.	89	CYRUS, B.	362
CARTER, H. J.	100	CZURDA, V.	469
CARTER, J. H.	339		
CASTELLANI, A.	479		
CATCHESIDE, D. G.	355		
CAWSTON, F. G.	97	DA COSTA LIMA, A.	238
CEJP, K.	477	DA CUNHA, A. M.	451
CENGIA-SAMBO, M.	280	DANGEARD, P.	268, 345, 467, 468, 470, 472
CHACHINA, A. G.	268	DANILOV, A. N.	283
CHADEFAUD, M.	268	DARLINGTON, C. D.	350
CHALK, L.	358	DARRAH, J. R.	448
CHALKLEY, H. M.	251	DAS GUPTA, B. M.	115, 116
CHANDLER, A. C.	449	DAS GUPTA, S. N.	372
CHAPMAN, F.	348, 455	DASTAR, J. F.	480
CHASE, W. H.	231	DAUBNEY, R.	328
CHATTAWAY, M.	130	DAVENPORT, C. B.	332, 333
CHATTON, E.	118, 451	DAVENPORT, H. A.	438
CHEESMAN, L. E.	103	DAVIDSON, J. E.	275
CHENG, L.	463	DAVIES, J. I.	325
CHENG, T.	235	DAVIS, A. C.	240
CHENG, T. H.	330, 333	DEARNESS, J.	141, 474
CHIBA, E.	341, 451	DE AZÚA, J. R.	361
CHILD, M.	271	DE BRITO, J.	112, 113
CHILDS, L.	139	DE LESDAIN, B.	375
CHING, R. C.	127	DE MEILLON, B.	100
CHRISTELLER, E.	232	DE MELLO, F.	112, 113
CHRISTENSEN, C.	360	DEMEREK, M.	239
CHURCH, C. C.	111	DE MEYERE, J. C. H.	439
CHURCH, G. L.	122	DEMPSTER, W. T.	329
CIFERRI, R.	140, 277, 367	DENNIS, E. W.	453
CLARKE, S. H.	359	DERX, H. G.	366
CLAUSEN, J.	120, 259	DE WILDEMAN, E.	344
CLAUSER, F.	437	DIEHL, W. W.	475
CLAY, R. S.	297	DIETEL, P.	476
CLEARE, L. D.	101	DIETZ, S. M.	271
CLELAND, R. E.	254, 355	DISS, A.	233
CLERK, W.	343	DIXON, H. N.	129, 266, 361
COLE, W. S.	248	DODD, A. P.	337
COLLA, S.	142	DODGE, B. O.	367, 474
CONKLIN, C.	346	DODGE, C. W.	280
CONN, H. J.	227, 325	DOLJANSKI, L.	92
COOKE, W. E.	15, 427	DOMIN, K.	145, 360
COONFIELD, B. R.	108	DONATIEN, A.	116
COPELAND, E. B.	359	DOUBROW, S.	92, 324
CORT, W. W.	242, 245	DREW, K. M.	469
CORTI, A.	102	DUFF, D. C. B.	438
COSTANTIN, J.	275	DU RIETZ, G. E.	146
COTNER, F. B.	364	DUTHIE, E. S.	328
COURT, T. H.	297		

	PAGE		PAGE
EARLAND, A. ..	38, 46, 161	GALLOWAY, J. J. ..	248
EDDINS, A. H. ..	137, 373	GAMS, H. ..	467
EDWARDS, E. E. ..	445	GATENBY, J. B. ..	20, 90
EDWARDS, F. W. ...	108	GATER, B. A. R. ..	106
EFTIMIU, P. ..	271	GATES, R. R. ..	254
ELENKIN, A. A. ..	283	GATES, W. H. ..	235
ELFORD, F. G. ..	461	GEORGI, E. A. ..	377
ELLIOTT, J. S. B. ..	370	GÉRARD, P. ..	329
ELSTON, A. H. ..	445	GESCHICKTER, C. F. ..	325, 435
ELTRINGHAM, H. ..	99, 101	GILLESPIE, R. ..	248
ENRIQUEZ, M. L. ..	328	GIRAULT, A. A. ..	445
ENTZ, G. ..	345	GIRZITSKA, Z. ..	272, 274
ERICHSEN, C. F. E. ..	281	GLASER, R. W. ..	91, 344
ERLANSOON, E. W. ..	257	GOEBEL, K. ..	465
EVANS, A. W. ..	466, 482	GOLA, G. ..	128
EZEKIEL, W. N. ..	479	GOLDFINCH, G. M. ..	103
		GOLUBEWA, M. M. ..	266
FAHRINGER, J. ..	339	GOODING, L. N. ..	481
FARRIES, E. H. M. ..	372	GOODSPEED, T. H. ..	457
FAWCETT, H. S. ..	373	GORCZYNSKI, T. ..	356
FELDMANN, J. ..	269	GOTO, S. ..	246, 342
FERNALD, M. L. ..	265	GOUGH, J. ..	229
FERRIS, G. F. ..	104	GRAFLINGER, T. ..	476
FIALA, G. F. ..	437	GRAHAM, R. J. D. ..	262
FICKE, H. M. ..	272	GRANT, R. T. ..	235
FIKRY, M. A. ..	387	GRASSI, P. P. ..	345
FINDLAY, G. M. ..	91	GRAUSTEIN, J. E. ..	464
FISCHER, E. ..	139	GREEN, D. E. ..	373
FISCHER-PIETTE, E. ..	233	GREGORY, B. B. ..	471
FITZPATRICK, H. M. ..	271	GRESSON, R. A. R. ..	335
FLETCHER, T. B. ..	104	GRIEVE, B. J. ..	358
FLOR, H. H. ..	365	GROVE, W. B. ..	274, 371, 478
FOLEY, J. O. ..	89	GUERRERO, P. G. ..	363
FORTI, A. ..	364	GUILLAUMOT, A. ..	467
FOUTS, R. ..	241	GUINEA, E. ..	361
FRAGOSO, R. G. ..	140	GWYNNE-VAUGHAN, H. ..	270
FRANCHINI, G. ..	118	GYELNIK, V. ..	281, 483
FRANCIS, W. D. ..	124		
FRANCONI, A. ..	88	HADJIOLOFF, A. ..	85
FRASER, C. I. ..	97	HAGELSTEIN, R. ..	484
FRASER, F. C. ..	102	HAIGH, J. C. ..	272
FREEMAN, L. B. ..	113	HÅKANSSON, A. ..	255
FRÉMY, P. ..	468	HALL, M. C. ..	102
FRENCH, R. W. ..	435	HALL, R. P. ..	89
FREY, E. ..	144, 146, 280, 281	HAMEL, A. ..	130
FROGGATT, W. W. ..	103	HAMEL, G. ..	130
FROST, F. H. ..	261	HAMILTON, T. D. ..	200
FUKUI, T. ..	341	HAMMETT, F. S. ..	96
FUKUSHIMA, E. ..	257	HANDSCHIN, E. ..	99, 238
FULTON, J. D. ..	229	HANNA, G. D. ..	424
FURUYAMA, T. ..	341	HANSEN, H. M. ..	278
		HANZAWA, S. ..	110
GAISER, L. O. ..	459	HARDY, G. H. ..	443
GALIANO, E. F. ..	326	HARLOW, W. M. ..	125

	PAGE		PAGE
HARSHBERGER, J. W.	142	JAAG, O.	147, 279
HARTMAN, C. G.	93	JACOT, A. P.	276
HASCHIMOTO, K.	234	JACQUIERT, C.	324
HATCH, M. H.	105	JAMES, W. M.	114
HAUGSJÄ, P. K.	484	JAMESON, A. P.	113
HAUPT, A. W.	127, 435	JANSSONIU, H. H.	125
HAYTHORN, A. R.	230	JAUEL, V.	275
HEATHER, A. H.	87	JENKINS, A. E.	372
HEDBERG, H. D.	455	JENKINS, W. A.	374
HEDGCOCK, G. G.	142	JIROVEC, O.	119
HEDRICK, J.	483	JOHNSON, B. K.	284
HEGNER, R.	116	JOHNSON, D. J.	128
HEIMANS, J.	469	JOHNSON, P. L.	113, 250
HEIMLICH, L. F.	257	JOHNSTON, C. O.	272
HEIN, I.	370, 479	JONES, G. N.	361
HELDMAYER, C.	137, 138	JONES, J.	468
HELMY, M.	244	JONES, S. G.	474
HERON-ALLEN, E.	38, 46, 161	JONES, T. D.	235
HICKMAN, J. R.	338	JORDAN, J. H.	87
HICKMAN, V. V.	340	JOSSEKAND, M.	369
HICKS, G. C.	255	JOYET-LAVERGNE, P.	233
HIGGINS, R. M.	469		
HILL, C. F.	15, 427		
HILLMAN, J.	280, 484		
HIRALSUKA, N.	476	KAGAWA, F.	253, 254
HIRST, S.	447	KAISER, K.	232
HIURA, M.	365	KAISER, P.	130
HJORT, E. V.	377	KÄMMERLING, H.	136
HODLEY, L.	327	KATER, J. M.	453
HOFFMAN, W. E.	469	KATÔ, K.	352
HOFKER, J.	246, 348, 349, 454	KATZ, N. J.	362
HOLLANDE, A. C.	323	KAWAKUBO, G.	441
HOLLINGSHEAD, L.	457, 458	KAZAO, N.	258
HOLMES, L. E.	462	KEEN, C. I.	261
HOLMES, W. C.	326, 436	KELLER, B.	374
HOLTUM, R. E.	360	KELLEY, L.	249, 347
HOMES, M.	260	KERN, F. D.	367
HOPKINS, D. L.	250	KHARBUSH, S. S.	271
HORNE, A. S.	284	KIDDER, G. W.	344
HORNING, E. S.	233, 327	KIHARA, H.	353
HORNOLD, A. G.	420	KIKUCHI, M.	353
HORSFALL, J. G.	135	KING, H. C.	261
HOWLAND, L. J.	267	KIRBY, H., Jr.	112
HRUBY, J.	140, 477	KLEBAHN, H.	475
HUFF, C. G.	343	KLIGLER, I. J.	92
HUGHES, R. C.	246	KLOTZ, L. J.	272
HULSENBERG, H.	276	KNIEP, H.	133, 365
HULTON, H. F. E.	134	KNOWLES, R.	115, 116
HYMAN, L. H.	109, 114	KOBAYASHI, H.	341
		KOBENDZA, R.	375
INARIYAMA, S.	258	KOFOD, C. A.	453
INGLEBY, H.	231	KONNO, T.	234
INNOCENTI, G. D.	110	KORNHAUSER, S. I.	227
ISHII, I.	459	KORSHIKOV, A. A.	267
ITO, T.	368	KOTTE, W.	277

	PAGE		PAGE
KOZUCHOV, Z. A.	459	McCARRISON, R.	233
KRIBS, D. A.	358	McCLINTOCK, J. A.	479
KRULL, W.	447	McCoy, O. R.	242, 448, 450
KRULL, W. H.	338	McDOWELL, E. C.	440
KRZEMIENIEWSKA, H.	284	McKINLEY, E. B.	91
KUFFERATH, H.	363	MACLACHLAN, C. M.	264
KÜHNER, R.	273	McLAUGHIN, G. D.	378
KUSANO, S.	364	McRAE, W.	367
KUTAK, V.	145	MAEDA, M.	351
KUWABARA, N.	451	MÄGDEFRAU, K.	127
		MAGNUSSON, A. H.	278
		MAGRON, J.	275
LACROIX, E.	249	MAINS, E. B.	271
LAIDLAW, G. F.	85	MALENÇON, G.	137
LAKOWITZ, D.	128	MALLOCH, J. R.	100, 104, 240
LAMBERT, E. B.	138, 475		337, 443
LARSEN, C. S.	463	MALYCHEV, N.	134
LARSON, E. E.	325	MAMELI-CALVINO, E.	374, 376
LAWRENCE, W. J. C.	351	MANALANG, C.	340
LEA, A. M.	240	MAPLESTONE, P.	245
LEA, A. N.	447	MARESQUELLE, H. J.	368
LEANDRI, J.	359	MARQUAND, C. V. B.	465
LEBOUR, M. V.	362	MARTIN, G. W.	129
LE CLERQ, E. L.	370	MARTIN, L. C.	284
LECLERQ, S.	264	MARTIN, M. S.	269
LEDENTU, G.	116	MASLEN, A. J.	462
LEDoux, P.	261	MASON, C. W.	377
LEFÈVRE, M.	345	MATHIAS, P.	448
LEHMANN, F. H.	441	MATTHEWS, J. R.	264
LE MAITRE, D.	456	MATTHEY, R.	234
LENDNER, A.	473	MATTICK, F.	143
LENTZE, H.	88	MATTIROLO, O.	141, 275
LEONIAN, L. H.	135, 475	MAYFIELD, A.	482
LESTOQUARD, F.	116	MEILDAZIS, J. J.	242
LEVINE, M. N.	136	MELBURN, M. C.	259
LIGHT, S. F.	240, 337	MELZER, V.	368, 369
LILLIE, R. D.	228, 439	MENDELEEFF, P.	234
LINDER, D. H.	134, 273	MENGE, F.	465
LINDSAY, R. H.	120	MERLAND, P. A.	233
LINK, G. K. K.	141	MERRILL, G. K.	281
LIou, M.	136	MERZ, C.	275
LLUECA, F. G.	109	METCALF, M. M.	250
LONG, W. H.	369	METZ, C. W.	94, 95, 332, 338
LONGINUS-NEVAS, R. P.	236, 237	MEURMAN, O.	256
LORD, E. M.	235	MEYER, J.	135, 367, 475
LOWE, E.	328	MEYLAN, C.	362, 466, 483, 484
LUCAS, M. S.	324	MEYRICK, E.	107
LUND, M.	278	MILLER, E. G.	302
LUNDBLAD, O.	237, 341	MILLER, H. M.	448
LUTZ, H. J.	462	MILLER, H. M., JR.	109
LUTZ, M. L.	369	MILLER, W. L.	263
LWOff, A.	118, 451	MIRZA, M. B.	245
LWOff, M.	118	MITRA, M.	480
LYNCH, J. E.	440, 452	MIX, H. J.	277
		MOFFETT, A. A.	350

	PAGE		PAGE
MOHENDRA, K. R.	480	OVERHOLTS, L. O.	479
MONK, C. R.	97	OWEN, H. H.	439
MONOYER, A.	358	OXNER, A. N.	282
MOORE, R. A.	230, 231	OZAKI, Y.	246, 342
MOREAU, F.	270		
MORGAN, T. H.	327	PALMER, D. K.	110
MORINAGA, T.	256, 257	PALMER, R.	221
MORISHITA, K.	342	PARKER, G. H.	326
MORITA, J. I.	93	PARROT, L.	116
MORSE, E. E.	477	PATTEN, R.	351
MOSES, M. S.	95	PAUTRIER, L. M.	233
MOTYKA, J.	375	PERCIVAL, J.	350
MOULTON, D.	445	PETERSEN, H. E.	485
MOYER, D. A.	454	PETERSON, A. R.	326, 436
MUCKENFUSS, R. S.	91	PETHYBRIDGE, G. H.	277
MUKERJI, R. N.	90	PETRAGNANI, G.	229
MUNIZ, J.	451	PETRAK, F.	140
MURPHY, A. J.	316	PHILIPPS, J. F. V.	282
		PIC, M.	339
NÁBĚLEK, F.	127	PICARD, F.	237
NAGAO, S.	353	PICBAUER, R.	141
NAKANISHI, S.	116	PIESCHEL, E.	276
NARASIMHAN, M. J.	269	PILÁT, A.	369
NASTA, M.	234	PLITT, C. C.	282
NAVASHIN, M.	121, 458	PODPÉRA, J.	129, 145
NÁYÁS, R. P. L.	339	POEVERLEIN, H.	136
NAYLOR, G. L.	376	POLICARD, A.	92, 436
NAZMI, M.	244	PORTER, C. L.	146
NEEDHAM, J.	329	POSTHUMUS, O.	465
NELSON, T. C.	129	POTIER DE LA VARDE, R.	128, 466
NEWMAN, I. V.	126	POULTON, E. B.	101
NICOLAS, G.	372, 373	POULTON, E. M.	268
NIGRELLI, R. F.	114	PRESTON, J. M.	485
NILSSON, G.	144, 280	PROUT, L. B.	102, 107
NOLF, L. O.	341		
NORMAN, A. G.	479	RADU, V.	234
NOYES, B.	446	RAI, H. S.	210
NYI, T. K.	460	RAMME, W.	237
		RAMSDEN, J. V.	376
OBRESHKOVE, V.	334	RAMSEY, G. B.	372
OCHI, Y.	234	RAO, H. S.	334
O'FLAHERTY, F.	378	RAPHÉLIS, A.	269
OKABE, S.	123	RASTÉGAÏEFF, E. F.	327
OKADA, S.	228	RAYES, T.	473
OKAJIMA, K.	433	RAYNER, M. C.	141
OKKELO, H.	232	REED, G. M.	273
OKKELS, H.	436	REES, C. W.	117, 439
OLDHAM, J. N.	236	REEVES, R. G.	356
OLLIVIER, G.	132	REHN, J. A. G.	104, 336
O'NEAL, W. S.	449	REIMERS, H.	129, 266, 466
ONO, T.	459	RHAMY, B. W.	433, 434
ONUMA, F.	368	RHEINAU, F. R.	101
OSTENFELD, C. H.	463, 485	RICHARDSON, E.	120

	PAGE		PAGE
RICHARDSON, K. C.	233	SECKT, H.	364
RICHTER, M. N.	440	SERGEANT, E.	116
RIDDELL, W.	109	SERVIT, M.	482
RIDDLE, O.	96	SESHAIYA, R. V.	334
RILEY, N. D.	101	SETCHELL, W. A.	472
RILEY, W. A.	245	SEVERIN, H. H. P.	446
RIVERS, T. M.	91	SHARP, L. W.	259
ROBERG, M.	366	SHEAR, C. L.	134
ROBERTSON, D.	243	SHEFFIELD, F. M.	254
ROSENHAIN, W.	316	SHERIDAN, W. F.	227, 228
ROSENVINGE, L. K.	131	SHERRIN, W. R.	466
ROUSSET, J.	324	SHIKHOBALOVA, N.	449
RUGE, H.	90	SHIMOTOMAI, N.	120
RUMBOLD, C. I.	366	SHINKE, N.	352
RYNIKER, C.	248	SHULL, A. F.	105
		SIBILLA, C.	139
		SICE, A.	116
SAGUCHI, S.	326	SIENICKA, A.	356
ST. JOHN, J. H.	118	SILVESTRI, A.	110
SALMON, E. S.	277	SIMMONS, C. W.	480
SAMBO, M. C.	147	SIMON, S. V.	359
SANBORN, E. I.	266	SINDEN, J. W.	271
SANDERS, E. P.	249, 250	SINGER, R.	139, 140
SANDGROUND, J. H.	243	SINGH, J.	480
SANFORD, G. B.	474	SKRJABIN, J.	448
SARLES, M. P.	243, 244, 449	SKUJA, H.	267
SARRASSAT, C.	466	SKVORTZOW, B. W.	267
SARTORY, A.	135, 367, 475	SLONIMSKI, P.	434
SARTORY, R.	135, 367, 475	SMILES, J.	307
SASS, J. E.	86	SMITH, D. C.	327
SATINA, S.	269	SMITH, E. C.	147, 477
SATIO, K.	435	SMITH, G. M.	97
SAUVAGEAU, C.	131, 132	SMITH, K. M.	335
SAVICZ, V. P.	483	SMITH, L. M.	444
SAVULESCU, F.	473	SNODGRASS, R. E.	236
SAWYER, W. H.	133	SOLHEIM, W. G.	475
SAX, K.	354, 358	SPARROW, F. K.	365
SAXTON, W. T.	263	SPENCE, G. C.	235
SBARBARO, C.	278	SPESSARD, E. A.	470
SCHAFFNER, J. H.	464	SPRAGUE, R.	135, 482
SCHAFFNIT, E.	274	STAKMAN, E. C.	136
SCHAPIRO, L.	242, 245	STARCS, K.	265
SCHENNIKOW, A. P.	266	STARMACH, K.	130, 131
SCHMIDT, O. C.	132	STEARN, A. E.	86, 228
SCHMUCK, M. L.	332	STEARN, E. W.	86
SCHROEDER, W. L.	468	STEARN, W. E.	228
SCHUMAKER, E.	116	STEGALL, P. A.	87
SCHUSSNIG, B.	362	STEVENS, E.	476
SCHWARTZ, W.	471	STEVENS, F. L.	477
SCHWETZ, J.	115	STEVENS, N. E.	134
SCOTT, F. M.	123	STEWART, K. C.	365
SCOTT, J. A.	242, 243, 449, 450	STEWART, L. B.	262
SCOTT, J. W.	343	STEWART, R. E.	346
SEAUER, F. J.	271, 366, 475	STILES, W.	326
SEBARD, P.	275	STOCKMANS, F.	362

	PAGE		PAGE
STOKEY, A. G.	464	UNAMUNO, L. M.	274
STOLL, N. R.	242, 245	UNAMUNO, P. L. M.	478
STOUGHTON, R. H.	276, 277, 481	UNEYA, Y.	446
STOUT, A. B.	255		
STRAND, E.	340	VALENTINE, W. W.	346
STRANI, M.	437	VANDENDRIES, R.	137, 477
STRÖM, K. M.	363	VAN DER VLERK, I. M.	110, 111
STRUBLE, R. E.	443	VAN DER WIJK, R.	265
STUNKARD, H. W.	342	VAN HAITSMA, J. P.	448
SUSA, T.	255	VAN RIJSINGE, C.	248
SWIFT, M. E.	366	VASUDEVA, R. S.	371, 480
SYDOW, H.	136, 140, 371	VAUCEL, M.	116
SZATALA, Ö.	144, 145	VERDOORN, F.	466
		VERPLANCKE, G.	273, 276, 476, 482
		VILHELM, J.	128, 129, 132
TAKAMATSU, M.	261	VILKOMERSON, I. M.	434
TAKANO, Y.	92	VILELA, E. L.	243
TAKUBO, S.	441	VOGELSANG, E.	343
TALBOT, G.	101	VOLK, A.	274
TANABE, M.	451	VOLKMAR, F.	113
TASUGI, H.	480	VON CHOLNOKY, B.	470
TAUBENHAUS, J. J.	479	VON SYDOW, H.	367
TAYLOR, W. R.	120, 472, 473		
TENNOIR, A. L.	339	WAGER, H. A.	129
TERAO, A.	98	WAGNER, N.	259
THÉRIOT, I.	466, 467	WALLACE, J. M.	136
THOMAS, E. N. M.	462	WALLIS, T. E.	30
THOMAS, L. J.	448	WALTER, V. C.	340
THOMAS, N. L.	347	WARD, T. J.	134
THOMPSON, W. P.	121, 122	WARE, W. M.	277
THOMPSON, W. R.	103	WATANABE, H.	434
THORN, C.	367	WATSON, H.	235, 236
THORPE, W. H.	442	WATSON, V. W.	483
TILDEN, J. E.	469	WATSON, W.	282
TILFORD, P. E.	481	WEATHERBY, J. H.	251
TIRELLI, M.	94	WEBER VAN BOSSE, A.	472
TOGASHI, K.	368	WEISS, E.	229, 439
TOKUNAGA, M.	445	WELCH, F.	34
TONNOIR, A. L.	240	WENNEKERS, J. H. L.	110
TORO, R. A.	142	WENRICH, D. M.	112, 114
TORRES, C. M.	243	WESLEY, O. C.	363
TRAVASSOS, L.	245, 342, 343	WESTBROOK, M. A.	471
TRELA, J.	357	WESTBROOK, M. H.	363
TSANG, K. C.	133	WESTON, W. H.	133
TUAN, H. C.	436	WHITAKER, D.	327
TUDANCA, I. C.	328	WICKENDEN, R. T. D.	348
TURNER, A. J.	336, 442, 445	WIGGLESWORTH, V. B.	236, 335
TURNER, J. P.	452	WIGODER, S. B.	90, 351
TYZZER, E. E.	343	WILLIAMS, O. L.	449
		WILLIAMSON, H. S.	270
UDINZEW, A. N.	448	WILLIS, H. G.	282
UGRIUMOW, B.	88	WILSON, M.	368
ULLIAN, S. S.	95	WILTSHIRE, S. P.	135
UMBROVE, J. H. F.	111	WODEHOUSE, R. P.	460

	PAGE
WOLF, J.	87
WOMERSLEY, H.	241
WOOD, A. E.	359
WOODHEAD, A. E.	108, 246, 342
WOOLLETT, M. L.	146
WORONICHIN, N. N.	268
WU, G. M.	470
YABE, H.	110
YAKIMOFF, W. L.	327
YAMADA, Y.	470, 471, 473
YAMASAKI, M.	344

	PAGE
YOUNG, E. M.	478
YUASA, H.	446
ZABLOCKA, W.	272
ZAHLBRUCKNER, A.	281
ZALESSKY, M.	264, 265
ZANON, D. V.	129
ZELLER, S. M.	139, 481
ZIRKLE, C.	123, 124
ZOARA, M.	369
ZUNDEL, G. L.	273
ZUNDEL, G. L. I.	368

